

What is claimed is:

1. A graphical display method for hierarchical structures, which can display graphically
5 hierarchical structures of nodes from the nodes that are branch points, relay points, or end
points corresponding to apparatuses or functions and the connection relationships between the
nodes, the method comprising the steps of

arranging the nodes of the same layer subordinate to the same node on the same
ellipse, and

- 10 arranging the subordinate ellipse of the same layer is arranged concentrically on an
ellipse larger than the ellipse of the upper layer.

2. A graphical display method for hierarchical structures according to Claim 1 wherein
the size of said ellipse changes depending on the number of nodes arranged on said same
15 ellipse.

3. A graphical display method for hierarchical structures according to Claim 2 wherein
the ratio of the minor axis to the major axis of said ellipse determined corresponding
to the ordinate to abscissa ratio of the display area and
20 the length of the minor axis and major axis of the ellipse calculated corresponding to
the ratio of the number of nodes arranged on said same ellipse.

4. A graphical display method for hierarchical structures according to Claim 1 wherein:
the arrangement of nodes on said same ellipse is changed according to the number of
25 nodes on the lower layer.



5. A graphical display method for hierarchical structures according to Claim 4 wherein said arrangement of nodes on the ellipse according to the number of nodes of the lower layer is carried out by the steps of:

partitioning the circumference of the ellipse on which the nodes are arranged
 5 corresponding to according to the ratio of the number of nodes of the lower layer subordinate to each node arranged in said same ellipse, and
 arranging each node on the center point of each partitioned arc.

6. A graphical display method for hierarchical structures according to Claim 1 wherein:
 10 the arrangement of the ellipses in said same layer is changed according to the number of nodes arranged in said same ellipse.

7. A graphical display method for hierarchical structures according to Claim 6 wherein said arrangement of ellipses of the same layer according to the number of nodes arranged on
 15 said same ellipse carried out by the steps of:

constructing a concentric ellipse larger than the upper layer,
 determining the circumference of said concentric ellipse or a part of the
 circumference as a locus of the centers of each ellipse upon which nodes are of the same layer
 arranged,
 20 partitioning an arc of the locus of the centers according to the ratio of the number of nodes arranged of said each ellipse, and
 determining the center point of the partitioned arc as a center position of each ellipse.

8. A graphical display method for hierarchical structures according to Claim 1 wherein
 25 said graphical display of the hierarchical structure of the nodes is carried out by:
 determining the ratio of the size of the ellipse of each layer and the ratio of the minor



axis and major axis of the ellipses based on the hierarchical structure of the nodes, and
determining a size of the ellipses of each layer according to a display area

constructing ellipse of the first layer based on said determined value,

constructing the locus of the centers of ellipses of the second layer centered on said
5 ellipse of the first layer, and at a distance where the ellipses of the first layer and the second
layer do not overlap,

constructing ellipses of the second layer centered on the locus for the centers of
ellipses of the second layer at a position depending on the number of nodes arranged on each
ellipse of the second layer, and whose size is a function of the number of arranged nodes,

10 arranging nodes on the ellipses according to the number of nodes subordinate to each
node of the second layer, and

repeating the processing in the same manner as said processing for the third.

9. A graphical display method for hierarchical structures according to Claim 1 wherein
15 said ellipse is a circle.

10. A graphical display method for hierarchical structures according to Claim 9 wherein:
the size of the circle upon which said nodes are arranged is determined such that the
circle upon which the nodes of the lower layer subordinate to each node are arranged is made
20 the largest.

11. A graphical display method for hierarchical structures according to Claim 10 wherein
said determination in which the circle on which the nodes of the lower layer subordinate to
each node is made the largest is carried out by the steps of:

25 partitioning the center angle of the circle on which the nodes are arranged by the
number of nodes arranged on the same circle,



constructing an inscribed circle in the smallest area formed by this partition line and the display border line, and

for the layer excluding the lowest layer, making the radius of the circle upon which the nodes are arranged the length from the center of the circle to the inscribed circle, or less,
5 or for the lowest layer, making the radius of the circle upon which nodes are arranged equal to the radius of the inscribed circle, or less.

12. A graphical display method for hierarchical structures according to Claim 9 wherein:
the arrangement of the nodes on the circle is carried out by equally partitioning the
10 center angle of the circle according to the number of arranged nodes.

13. A graphical display method for hierarchical structures according to Claim 12 wherein said equal partitioning of the center angle of the circle according to the number of arranged nodes is carried out by the steps of:

15 equally partitioning the center angle of the circle upon which nodes are arranged by the number of arranged nodes for the highest layer, and
equally partitioning the center angle by a value adding 1 to the number of nodes arranged on the same circle, and arranging the nodes for the nodes of the second layer and less.

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14. A graphical display method for hierarchical structures according to Claim 9 wherein said arrangement of circles of the same layer is performed by:

arranging the circles of the said same layer equally spaced on a circle whose center is the center of the circle of the upper layer and whose radius is the length adding the radius of
25 the largest circle on the circle of the same layer to the radius of the upper layer, or more.



15. A graphical display method for hierarchical structures according to Claim 14 wherein said arrangement of circles of the same layer is carried out by the steps of:

determining the center of the circle of the upper layer as the center for nodes of the second layer or less,

5 constructing a circle, the length of whose radius is the radius of the circle of the upper layer added to the radius of the inscribed circle constructed when calculating the radius of the circle of the upper layer, and

determining the intersection of the extensions of straight lines from the center of the circle of the upper layer to the upper node and the constructed circle as the center of the circle
10 on which the nodes are arranged.

16. A graphical display method for hierarchical structures according to Claim 9 wherein said graphical display of a hierarchical structure of the nodes is carried out by the steps of:

equally partitioning a center angle of the circle upon which nodes are arranged by the
15 number of nodes arranged on the same circle,

constructing an inscribed circle in the smallest area formed by this partition line and the display border line,

constructing a circle upon which nodes are arranged, the radius thereof being determined as the distance from the center of the circle to the inscribed circle, or from the
20 radius of the inscribed circle,

arranging nodes by equally partitioning the center angle according to the number of arranged nodes,

constructing a circle whose radius is the radius of the circle of the upper layer added to the radius of the inscribed circle, and determining the intersection of the extensions of the
25 straight lines from the center of the circle of the upper layer to the upper nodes as the center of a circle on which the nodes of the second layer and less are arranged, and



repeating the processing in the same manner as the above processing for undisplayed nodes.

17. A graphical display method for hierarchical structures according to Claim 9 wherein:

5 said radius of a circle upon which said nodes are arranged is calculated based on the number of nodes in the lower layers.

18. A graphical display method for hierarchical structures according to Claim 17 wherein said calculation based on the number of nodes of the lower layer is carried out by the steps of:

10 partitioning the center of a circle on which nodes are arranged according to the ratio of the number of nodes of the lower layers subordinate to each node arranged on the same circle, constructing an inscribed circle in the smallest area formed by the extensions of its greatest partition angle and the display border line, making the radius of the circle upon which nodes are arranged the length from the center of the circle to the inscribed circle, in the case
15 excluding the lowest layer, and

constructing an inscribed circle in the area formed by the extensions of each partition angle formed when the nodes of the upper layer are arranged, and the display border line making the radius of the circle upon which nodes are arranged the equal length of the radius of its inscribed circle for the lowest layer.

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19. A graphical display method for hierarchical structures according to Claim 9 wherein:

said position of the nodes of each layer on the same circumference upon is arranged according to the partition angle calculated from the number of nodes of the lower layers of each node.

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20. A graphical display method for hierarchical structures according to Claim 19 wherein



said arrangement according to the partition angle calculated from the number of nodes of the lower layer of each node is carried out by the steps of:

arranging the nodes according to each partition angle constructed when calculating the radius of the circle upon which nodes are arranged for the layers excluding the lowest

5 layer, and

arranging the nodes by partitioning according to the number of nodes arranged on the same circle for the lowest layer.

21. A graphical display method for hierarchical structures according to Claim 9 wherein

10 said center of the circle upon which nodes are arranged among the nodes in the second layer or lower is carried out by the steps of:

constructing an inscribed circle in the area formed by the extensions of each partition angle constructed when calculating the radius of the circle upon which nodes of the upper layer are arranged and the display border line, and

15 determining the center of said inscribed circle as the center of each circle upon which nodes are arranged.

22. A graphical display method for hierarchical structures according to Claim 9 wherein

said graphical display of the hierarchical structure of nodes is carried out by the steps of:

20 partitioning the center of a circle upon which nodes are arranged according to the ratio of the number of nodes on the lower layer subordinate to each node arranged on the same circle,

constructing an inscribed circle in the smallest area formed by the extensions of the largest partition angles and the display border line, and constructing a circle upon which

25 nodes are arranged calculating the radius of the circle upon which nodes are arranged to be the length from the center of the circle to the inscribed circle,



arranging the nodes according to the partitioned angle,

constructing an inscribed circle in the area formed by the extensions of each partition angle and the display border line, and determining the center of each inscribed circle as the center of each circle upon which nodes of the lower layer are arranged, and

5 repeating in the same manner said processing for any undisplayed nodes.

23. A graphical display method for hierarchical structures according to Claim 9 wherein:
the radius of the circle upon which the nodes are arranged is calculated based on the number of layers in the lower layers.

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24. A graphical display method for hierarchical structures according to Claim 23 wherein said calculation based on the number of layers in the lower layers is carried out by the steps of:

partitioning the center of a circle upon which the nodes are arranged according to the
15 ratio of the number of layers on the lower layer subordinate to each node arranged on the same circle, constructing an inscribed circle in the smallest area formed by the extensions of the largest partition angles and the display border line, and determining the length from the center of the circle to the inscribed circle as the radius of the circle upon which circles are arranged, for the layers excluding the lowest layers, and

20 constructing an inscribed circle in the area formed by the extensions of each partition angle formed when the nodes are disposed in the upper layer and the display border line, and determining the length equal to the radius of this inscribed circle as the radius of the circle upon which nodes are arranged, for the lowest layer.

25 25. A graphical display method for hierarchical structures according to Claim 9 wherein said position of the arrangement on the same circumference of nodes of each layer is carried



out using the partition angle calculated from the number of layers of the lower layer of each node.

26. A graphical display method for hierarchical structures according to Claim 25 wherein said positioning using the partition angles calculated from the number of layers of the lower layers of each of said nodes is carried out by the steps of:

positioning the nodes according to each partition angle formed when calculating the radius of the circle upon which nodes are arranged for the layers excluding the lowest layer, and

positioning the nodes equally spaced according to the number of nodes arranged on the same circle for the lowest layers.

27. A graphical display method for hierarchical structures according to Claim 9 wherein said center of the circle upon which the nodes of the second layer and below are arranged is carried out by the steps of:

constructing an inscribed circle constructed in an area formed by the extensions of each partition angle formed when calculating the radius of the circle upon which the upper layer nodes are arranged and the display border line, and

determining the center of the inscribed circle as the center of the circles upon which the nodes are arranged.

28. A graphical display method for hierarchical structures according to Claim 9 wherein said graphical display of the hierarchical structures of said nodes is carried out by the steps of:

partitioning the center of the circle upon which nodes are arranged according to the ratio of the number of layers of the lower layers subordinate to each node positioned on the same circle,

constructing an inscribed circle in the smallest area formed by the extensions of the



largest partition angles and the display border line, constructing a circle upon which the nodes are arranged by determining the length from the center of the circle to the inscribed circle as the radius of the circle upon which the nodes are arranged, and arranging the node according to the positioned angle, and

5 processing in the same manner as the above processing is repeated in the same manner for undisplayed nodes.

29. A graphical display method for hierarchical structures according to Claims 1, 9, 17, and 23 wherein when nodes of the upper layer and nodes two or more layers lower are
10 directly connected:

 the nodes of the same layer subordinate to the same node are arranged on the same ellipse, and

 nodes of the middle layers where there are parts for which corresponding nodes do not exist in said layers because of direct connection between the upper and lower nodes are
15 arranged on ellipses constructed in the interior of node arranging ellipses of the lower layer nodes.

30. A graphical display method for hierarchical structures according to Claim 29 wherein when the nodes of the upper layer nodes and the nodes two or more layers lower are directly
20 connected, the graphical display method is carried out by the steps of:

 constructing an ellipse for the nodes of the same layer subordinate to the same node,
 arranging the nodes of the same layer on the constructed ellipse when it is decided that there are no middle layers where some nodes do not exist,

 arranging the nodes of a lower layer on the constructed ellipse, constructing the
25 second ellipse in the interior of said ellipse, and arranging the nodes of the middle layer on said second ellipse when it is decided that there are middle layers where nodes do not exist,



and

determining whether or not there are any undisplayed nodes, repeating the above processing if there are undisplayed nodes, and ending the processing if there are none.

5 31. A graphical display method for hierarchical structures according to Claims 9, 17, 23, and 29 wherein when a plurality of hierarchical structures is connected, the graphical display method is carried out by the steps of:

partitioning the display area of the display part by the number of unitary hierarchical structures whose nodes of the highest layer are independent,

10 arranging nodes included in the same highest layer of each hierarchical structure on the circumference of the ellipse drawn in the center of each display area for, and

arranging the nodes of lower layers on a concentric ellipse larger than the ellipse of the upper layer nodes, and arranging as near as possible the positions of nodes of the part connecting other hierarchical structures.

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32. A graphical display method for hierarchical structures according to Claim 31 wherein the arranging the ellipses of each layer, and arranging the nodes on the same ellipse is carried out by determining the position of the shortest distance on the ellipse to the partition line of the display area as the base point, and arranging the nodes which connect with the other

20 hierarchical structures the ellipses of this upper layer on this base point.

33. A graphical display method for hierarchical structures according to Claims 9, 17, 23, 29, and 31 wherein said links showing the vertical relationships of the nodes are carried out by branching at a position where straight lines issuing from the upper layer nodes do not
25 overlap the other links, and connecting them to each node of the lower layer.



34. A graphical display method for hierarchical structures according to Claim 33 wherein the branch point of said links connects each node of the lower at the point which is located on a straight line from the center of the ellipse where the nodes of said layer are connected to the upper node, and on the straight line issuing from the node of the upper layer up to where it is
5 tangent to the ellipse of the lower layer.

35. A graphical display apparatus for hierarchical structures comprising:

a data structure analysis unit which reads data related to the hierarchical structure of apparatuses and functions corresponding to branch points, relay points, and end points

10 analyses the input data,

a node arrangement calculation unit which arranges the nodes of the same layer subordinate to the same node on the same ellipse from the results of analysis of the said data structure analysis unit, and carries out calculation of the node arrangement positions by arranging ellipses of the same lower layer on concentric ellipses larger than the ellipse of the
15 upper layer,

a link connection calculation unit which carries out calculation of the link connections showing the connection relationships between said nodes from the results of the analysis of said data structure analysis unit and the node arrangement positions of said node arrangement calculation unit, and

20 an image construction unit which carries out construction of the output image for output to an apparatus using the calculation results from said node arrangement calculation unit the said link connection calculation unit.

36. A graphical display apparatus for hierarchical structures according to Claim 35

25 wherein said node arrangement calculation unit is provided with:

a node arrangement locus calculation unit which constructs an ellipse which is the



locus for arranging nodes of the n^{th} layer (n is an integer equal to or greater than 1) based on the value determined by said data structure analysis unit,

a node position calculation unit which arranges nodes on an ellipse calculated by said node arrangement locus calculation according to the number of nodes subordinate to each node of the n^{th} layer, and

a layer arrangement position calculation unit which carries out calculation of the layer arrangement position by constructing a locus centered on the ellipse of said n^{th} layer for the centers of ellipses of the $(n + 1)^{\text{th}}$ layer at a distance where ellipses of the n^{th} layer and the $(n + 1)^{\text{th}}$ layer do not overlap, and further

said node arrangement locus calculation unit constructs ellipses which are the locus of the node arrangement by:

constructing an ellipse in a prescribed position in the case of the first layer, and

constructing an ellipse for the m^{th} layer (m is an integer equal to or greater than 2)

whose size depends on the number of arranged nodes, and sets the center at a position

depending on the number of nodes arranged on each ellipse of the m^{th} layer on the locus for the center of ellipses of the m^{th} layer calculated by the said layer arrangement position calculation unit in the case of layers of the m^{th} layer (m is an integer equal to or greater than 2).

37. A graphical display apparatus for hierarchical structures according to Claim 35 wherein the ellipse used in order to arrange nodes by said node arrangement calculation unit is a circle.

38. A graphical display apparatus for hierarchical structures according to Claim 37

wherein said node arrangement calculation unit is provided with:



a node arrangement locus calculation unit which calculates the locus on which nodes are arranged by equally partitioning the center angle of a circle upon which nodes are arranged by the number of nodes arranged on the same layer, constructing an inscribed circle in the smallest area formed by this partition line and the display border line, and calculating a
 5 circle upon which nodes are arranged by calculating the radius of the circle upon which nodes are arranged from the distance from the center of the circle to the inscribed circle or the radius of the inscribed circle,

a node position calculation unit which calculates the positions on which nodes are arranged by partitioning the central angle according to the number of nodes arranged on the
 10 circle calculated by said node arrangement locus calculation unit, and

a layer arrangement calculation unit which calculates the layer arrangement positions by fixing the center of the circle upon which nodes of the first layer are arranged at a predetermined position in the case of the first layer, and in the case of the n^{th} layer (n is an integer equal to or greater than 2), constructing a concentric circle whose radius is the radius
 15 of the circle of the $(n - 1)^{\text{th}}$ layer calculated by said node arrangement locus calculation unit added to the radius of said inscribed circle, and determining the intersection of the straight line from the center of said $(n - 1)^{\text{th}}$ layer to each node of the $(n - 1)^{\text{th}}$ layer as the center of each circle upon which the nodes of the n^{th} layer are arranged.

20 39. A graphical display apparatus for hierarchical structures according to Claim 37 wherein said node arrangement calculation unit which carries out calculations of the radius of the circle upon which nodes are arranged based on the number of nodes of the lower layer.

40. A graphical display apparatus for hierarchical structures according to Claim 37
 25 wherein said node arrangement calculation unit is furnished with:

a node arrangement locus calculation unit which partitions the center of a circle upon



which nodes are arranged according to the ratio of the number of nodes of the lower layer subordinate to each node arranged on the same circle, constructs an inscribed circle in the smallest area formed by the extensions of the largest partition angle and the display border line, and calculates the locus which arranges nodes by constructing a circle upon which nodes
 5 are arranged by calculating the radius of the circle upon which nodes are arranged as the length from the center of the circle to the inscribed circle,

a node position calculation unit upon which arranges the nodes according to the partitioned angle on the circle calculated by said node arrangement locus calculation unit, and

a layer arrangement position calculation unit which calculates the layer arrangement
 10 position by fixing the center of the circle upon which the nodes of the first layer are arranged on a predetermined position in the case of the first layer, and in the case of the n^{th} layer (n is an integer equal to or greater than 2), constructing a concentric circle whose radius is the result of adding the radius of the circle of the $(n - 1)^{\text{th}}$ layer calculated by said node arrangement locus calculation unit and the radius of said inscribed circle, and determining the intersection
 15 of the extensions from the center of the circle of said $(n - 1)^{\text{th}}$ layer to each node of the of the $(n - 1)^{\text{th}}$ layer as the center of each circle upon which the nodes of the n^{th} layer are arranged.

41. A graphical display apparatus for hierarchical structures according to Claim 37 wherein said node arrangement calculation unit calculates the radius of the circle upon which
 20 nodes are arranged based on the number of layers of the lower layer.

42. A graphical display apparatus for hierarchical structures according to Claim 37 wherein said node arrangement calculation unit is provided with a arrangement locus calculation unit which calculates the locus upon which nodes are arranged, a node position
 25 calculation unit which calculates the position upon which nodes are arranged, and a layer arrangement position calculation unit which calculates the arrangement position of the layer,



and wherein

said node arrangement locus calculation unit which calculates the locus upon which nodes are arranged, in the case of the first layer by partitioning the center of the circle upon which nodes are arranged in proportion to the number of layers of the lower layer subordinate to each node positioned on the same circle, constructing an inscribed circle in the smallest area formed by the extensions of the largest partition angle and the display border line, and constructing a circle upon which nodes are arranged by calculating the length from the center of the circle to the inscribed circle as the radius of a circle upon which nodes are arranged, and in the case of the m^{th} layer (m is a integer equal to or greater than 2), by constructing a circle by calculating the radius from the constructed inscribed circle by said layer arrangement position calculation unit,

said node position calculation unit which arranges nodes on a circle calculated by said node arrangement locus calculation according to the partitioned angle in the case of the first layer, and in the case of the p^{th} layer (p is an integer equal to or greater than 2) partitions the center of the circle constructed by said node arrangement locus calculation unit according to the ratio of the number of layers of the lower layers subordinated to each node arranged on the same circle, and arranges the nodes on the circle according to the partitioned angle, and

said layer arrangement position calculation unit calculates the arrangement position of the layer by determining the center of a circle upon which the nodes of the first layer are arranged at a predetermined position in the case of the first layer, and in the case of the n^{th} layer by constructing an inscribed circle in the area formed by the display border line and the extensions of each partition angle of the $(n - 1)^{\text{th}}$ layer by said node arrangement locus calculation unit or node position calculation unit, and by determining the center of each inscribed circle as the center of each circle upon which nodes are arranged.

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43. A graphical display apparatus for hierarchical structures according to Claims 35, 37,



39, and 41 wherein said node arrangement calculation unit, in the case that an upper layer node is directly connected to a node two or more layers below:

arranges on the same ellipse nodes of the same layer subordinate to the same node,
and

5 arranges the nodes of the middle layer for which part has no nodes corresponding to the relevant layer when the nodes of vertical layers are directly connected on an ellipse constructed in the ellipse upon which nodes of the lower layer are arranged.

44. A graphical display apparatus for hierarchical structures according to Claim 43
10 wherein said node arrangement calculation unit:

constructs an ellipse with its object being the nodes of the same layer subordinate to the name node,

determines whether there is a middle layer whose nodes have no nodes in one part,
arranges nodes of the same layer on the constructed ellipse in the case that it is

15 determined that there are no layers without nodes in one part, and

arranges nodes of the lower layer on the constructed ellipse, constructs a second ellipse in said ellipse, and arranges the nodes of said middle layer on the second ellipse in the case that it is determined that there are layers without nodes in one part.

20 45. A graphical display apparatus for hierarchical structures according to Claims 35, 37, 39, 41, and 43 wherein said node arrangement calculation unit, in the case of a plurality of hierarchical structure is connected:

partitions the display area of the display part by the number of unitary hierarchical structures in which the upper layer nodes are independent,

25 arranges on the circumference of an ellipse drawn on the center of each display area in the case of the nodes included in the highest layer of each hierarchical structure, and



arranges at nearest positions the nodes of the part connecting the other hierarchical structures in such a way that nodes of the lower layers are arranged on a concentric ellipse larger than the ellipse of the upper layer in the case of the nodes of lower layers.

5 46. A graphical display apparatus for hierarchical structures according to Claim 45 wherein said node arrangement calculation unit determines the position closest to the partition lines of the display area as a base point, and arranges on the base point the nodes the other hierarchical layers or their upper layer ellipses when arranging the ellipses of each layer or when arranging the nodes on the same ellipse.

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47. A graphical display apparatus for hierarchical structures according to Claim 35, 37, 39, 41, 43, 45 wherein said link connection calculation unit is provided with:

a link branch position calculation unit which branches straight lines issuing from the nodes of the upper layer at a position where they do not overlap with other links, and connects
15 each node of the lower layer.

48. A graphical display apparatus for hierarchical structures according to Claim 47 wherein the branch point of said links connects each node of the lower at the point which is located on a straight line from the center of the ellipse where the nodes of said layer are
20 connected to the upper node, and on the straight line issuing from the node of the upper layer to where it is tangent to the ellipse of the lower layer.

49. A computer readable recording medium on which is recorded a hierarchical structure graphical display program for executing on a computer, the program performing the functions
25 comprising:

a data structure analysis function that reads data related to the hierarchical structure



of apparatuses and functions corresponding to branch points, relay points, and end points, and analyses the input data,

a node arrangement calculation function which carries out calculation of the node arrangement position from the results of analysis of said data structure analysis function by
 5 arranging the nodes of the same layer subordinate to the same node on the same ellipse and arranging the ellipses of the same lower layer on a concentric circle larger than the ellipse of the upper layer

a link connection calculation function which carries out calculation of the link connections showing the connection relationships of said nodes from the results of the
 10 analysis of said data structure analysis function and the node arrangement position of said node arrangement calculation function, and

an image generation function which carries out construction of the image for output to the output apparatus by using the results of calculation from said node arrangement calculation function and said link connection calculation function.

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50. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 49 which constructs an ellipse which is the locus upon which nodes are arranged by:

said data structure analysis function determining the ratio of the size of the ellipses of
 20 each layer and the ratio of the minor axis and major axis of the ellipse used for node arrangement in said node arrangement calculation function based on the hierarchical structure of the analyzed nodes, and further determining the size of the ellipses of each layer according tot the display area, and

wherein said node arrangement calculation function is furnished with:

25 a node arrangement locus calculation unit which constructs an ellipse which is the locus for arranging nodes of the n^{th} layer (n is an integer equal to or greater than 1) based on



the value determined by said data structure analysis function,

a node position calculation function which arranges the nodes on an ellipse calculated by said node arrangement locus calculation according to the number of nodes subordinate to the same node of the n^{th} layer, and

5 a layer arrangement position calculation unit which carries out calculation of the layer arrangement positions by constructing a locus for the center of ellipses of the $(n + 1)^{\text{th}}$ layer at a distance where the n^{th} layer and the $(n + 1)^{\text{th}}$ layer do not overlap on the center of the ellipse of said n^{th} layer, and further

said node arrangement locus calculation unit construct ellipses at a predetermined
10 position for the first layer, and

constructing an ellipse for the m^{th} layer (m is an integer equal to or greater than 2) whose size depends on the number of arranged nodes, and sets the center at a position depending on the number of nodes arranged on each ellipse of the m^{th} layer calculated by said layer arrangement position calculation unit in the case of layers of the m^{th} layer (m is an
15 integer equal to or greater than 2).

51. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 49 wherein the ellipse used in order to arrange nodes by said node arrangement calculation unit is a circle.

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52. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 51 provided with:

a node arrangement locus calculation function which calculates the locus on which nodes are arranged by equally partitioning the center angle of a circle upon which nodes are
25 arranged by the number of nodes arranged on the same layer, constructing an inscribed circle in the smallest area formed by this partition line and the display border line, and calculating a



circle upon which the nodes are arranged by calculating the radius of the circle upon which nodes are arranged from the distance from the center of the circle to the inscribed circle or the radius of the inscribed circle,

a node position calculation function which calculates the position on which nodes are arranged by equally partitioning the center angle according the number of nodes arranged on the circle calculated by said node arrangement locus calculation function, and

a layer arrangement calculation unit which calculates the layer arrangement positions by fixing the center of the circle upon which nodes of the first layer are arranged at a predetermined position in the case of the first layer, and in the case of the n^{th} layer (n is an integer equal to or greater than 2), constructing a concentric circle whose radius is the result of adding the radius of the circle of the $(n - 1)^{\text{th}}$ layer calculated by said node arrangement calculation unit and the radius of said inscribed circle, and determining the intersection of the straight line from the center of said $(n - 1)^{\text{th}}$ layer to each node of the $(n - 1)^{\text{th}}$ layer as the center of each circle upon which the nodes of the n^{th} layer are arranged.

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53. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 49 wherein said node arrangement calculation function calculates the radius of the circle upon which nodes are arranged based on the number of nodes in the lower layers.

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54. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 51 wherein said node arrangement calculation function is provided with:

a node arrangement locus calculation function which partitions the center of a circle upon which nodes are arranged according to the ratio of the number of nodes of the lower layer subordinate to each node arranged on the same circle, constructs an inscribed circle in



the smallest area formed by the extensions of the largest partition angle and the display border line, and calculates the locus which arranges nodes by constructing a circle upon which nodes are arranged by calculating the radius of the circle upon which nodes are arranged as the length from the center of the circle to the inscribed circle,

5 a node position calculation function which arranges the nodes according the partitioned angle on the circle calculated by said node arrangement locus calculation unit, and
 a layer arrangement position calculation function which calculates the layer arrangement position by fixing the center of the circle upon which nodes of the first layer are arranged on a predetermined position in the case of the first layer, and in the case of the n^{th}
 10 layer (n is an integer equal to or greater than 2), constructing a concentric circle whose radius is the result of adding the radius of the circle of the $(n - 1)^{\text{th}}$ layer calculated by said node arrangement locus calculation unit and the radius of said inscribed circle, and determining the intersection of the extensions from the center of the circle of said $(n - 1)^{\text{th}}$ layer to each node of the $(n - 1)^{\text{th}}$ layer as the center of each circle upon which the nodes of the n^{th} layer are
 15 arranged.

55. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 51 wherein said node arrangement calculation function calculates the radius of the circle upon which nodes are arranged based on the
 20 number of layers of the lower layers.

56. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 51 wherein said node arrangement calculation function is furnished with:

25 an arrangement locus calculation unit which calculates the locus upon which nodes are arranged, a node position calculation unit which calculates the position upon which nodes



are arranged, and a layer arrangement position calculation unit which calculates the arrangement position of the layer, and wherein

said node arrangement locus calculation function which calculates the locus upon which nodes are arranged, in the case of the first layer by partitioning the center of the circle upon which nodes are arranged in proportion to the number of layers of the lower layer subordinate to each node positioned on the same circle, constructing an inscribed circle in the smallest area formed by the extensions of the largest partition angle and the display border line, and constructing a circle upon which nodes are arranged by calculating the length from the center of the circle to the inscribed circle as the radius of the circle upon which nodes are arranged, and for the m^{th} layer (m is an integer equal to or greater than 2) by constructing a circle by calculating the radius from the constructed inscribed circle by said layer arrangement position calculation function,

said node position calculation unit arranging nodes on the circle calculated by said node arrangement locus calculation according to the partitioned angle function for the first layer, and for the p^{th} layer (p is an integer equal to or greater than 2) partitions the center of the circle constructed by said node arrangement locus calculation function according to the ratio of the number of layers of the lower layers subordinate to each node arranged on the same circle, and arranges nodes on this circle according to the partitioned angles, and

said layer arrangement position calculation function calculates the arrangement position of the layer, by determining the center of a circle upon which nodes of the first layer are arranged at a predetermined position in the case of the first layer, and in the case of the n^{th} layer by constructing an inscribed circle in the area formed by the display border line and said node position calculation unit, and by determining the center of each inscribed circle as the center of each circle upon which nodes are arranged.

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57. A computer readable recording medium on which is recorded a hierarchical structure



graphical display program according to Claims 49, 51, 53, and 55 wherein said node arrangement calculation function:

arranges nodes of the same layer subordinate to the same node on the same ellipse when the upper layer nodes are directly connected to the nodes 2 or more layers below, and

5 arranges the nodes of the middle layer where upper and lower nodes are directly connected and there are parts without nodes corresponding to said layer on an ellipse constructed by the function in the arrangement ellipse of the lower nodes.

58. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 57 wherein said node arrangement calculation function:

constructs an ellipse with its object being the nodes of the same layer subordinate to the same node,

15 determines whether there is a middle layer whose nodes do not have nodes in one part,

arranges nodes of the same layer on the constructed ellipse in the case that it is determined that there are no layers without nodes in one part, and

20 arranges nodes of the lower layer on the constructed ellipse, constructs a second ellipse in said ellipse, and arranges the nodes of the middle layer on said second ellipse in the case that it is determined that there are middle layers without nodes in one part.

59. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claims 49, 51, 53, 55 and 57 wherein, in the case of a plurality of hierarchical structures are connected, said node arrangement calculation function:

25 partitions the display area of the display function by the number of unitary hierarchical structures in which the nodes of the highest layers are independent,



arranges on the circumference of an ellipse drawn at the center of each display area in the case of nodes included in the highest layer of each hierarchical structure, and

arranges at nearest positions nodes of the part connecting the other hierarchical structures in such a way that the nodes on the lower layers are arranged on a concentric ellipse
5 larger then the ellipse of the upper layer in the case of nodes of lower layers.

60. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 59 wherein said node arrangement calculation function determines the position closest to the partition lines of the display area as a base
10 point, and arranges on the base point the nodes which connect with the other hierarchical layers or their upper layer ellipses when arranging the ellipses of each layer or when arranging the nodes on the same ellipse.

61. A computer readable recording medium on which is recorded a hierarchical structure
15 graphical display program according to Claim 49, 51, 53, 55, 57, and 59 wherein said link connection calculation function is provided with:

a link branch position calculation function which branches straight lines issuing from nodes of the upper layers at a position where they do not overlap with other links, and connects each node of the lower layer.

20 62. A computer readable recording medium on which is recorded a hierarchical structure graphical display program according to Claim 61 wherein said link branch position calculation function connects each node of the lower layer by branching a straight line at a position up to where the straight line issuing from the node of the upper layer meets the
25 ellipse of the lower layer on the straight line connecting the center point of the circle upon which the nodes of the layer are arranged and the upper node, and connecting each node of



the lower layer.



* C L M S *