What is Claimed is:

1. An apparatus configured to render an object comprising a path, the apparatus comprising:

a storage circuit;

an arithmetic circuit configured to:

determine directions of a plurality of primitives in the path, based on path data,

generate primitive direction information,

control to store the primitive direction information in the storage circuit, and

generate a winding number of each of a plurality of pixels using the stored primitive direction information; and

a determination circuit configured to determine whether a shading operation is to be performed based on the generated winding number,

wherein, when a number of plurality of primitives in the path exceeds a storable bit number of a storage area of the storage circuit, the arithmetic circuit is further configured to perform a pre-processing operation on the path data to adjust the number of plurality of primitives to the storable bit number of the storage area or to less than the storable bit number of the storage area.

2. The apparatus of claim 1, wherein the arithmetic circuit is further configured to:

generate a primitive mask of each of the plurality of pixels based on whether an imaginary line extending from each of the plurality of pixels in a first direction intersects with at least one of the plurality of primitives,

perform an arithmetic operation using the generated primitive mask and the stored primitive direction information, and

generate the winding number of each of the plurality of pixels.

3. The apparatus of claim 2, wherein the arithmetic circuit is further configured to determine whether the plurality of primitives have a second direction or a third direction, and

wherein the first direction is perpendicular to each of the second direction and the third direction.

4. The apparatus of any one of claims 1 to 3, wherein the arithmetic circuit is further configured to perform operations of generating winding numbers of the respective ones of the plurality of pixels in parallel.

5. The apparatus of any one of claims 1 to 4, wherein the storage circuit comprises at least one storage area configured to store N-bit information, wherein N is an integer equal to or more than 1, and

the arithmetic circuit is further configured to store the primitive direction information in bit areas of the storage area corresponding to each of the plurality of primitives.

6. The apparatus of any one of claims 1 to 5, wherein the pre-processing operation comprises:

dividing the path into at least two sub-paths, and

generating the primitive direction information for each of the at least two sub-paths.

7. The apparatus of any one of claims 1 to 5, wherein the pre-processing operation comprises:

dividing a tile corresponding to the path data when the apparatus renders the object comprising the path using a tile-based rendering method.

8. The apparatus of any one of claims 1 to 7, wherein the storage circuit comprises at least one from among a plurality of registers, a plurality of flip-flops, and a plurality of special registers having multi-ports, which respectively corresponds to a plurality of storage areas used to generate the winding number.

9. The apparatus of any one of claims 1 to 8, wherein the path data comprises information about a color assignment rule based on the winding number, and

wherein the determination circuit is further configured to perform a shading operation based on the winding number and the color assignment rule.

10. The apparatus of any one of claims 1 to 9, wherein, when the generating of the winding number is completed based on the path data, the arithmetic circuit is further configured to control to delete the primitive direction information stored in the storage circuit to generate a winding number for next path data.

11. A method of rendering an object comprising a path using a graphics processing apparatus, the method comprising:

obtaining path data comprising information on vertexes in the path and a command corresponding to the path;

generating primitive direction information indicating a direction of a plurality of primitives in the path, based on the path data;

performing a pre-processing operation on the path data to adjust a number of plurality of primitives to a storable bit number of a storage area or to less than the storable bit number of the storage area based on the number of plurality of primitives in the path exceeding the storable bit number of the storage area;

generating a winding number of each of a plurality of pixels using the primitive direction information; and

determining whether a shading operation is to be performed based on the winding number.

12. The method of claim 11, wherein the generating of the primitive direction information comprises:

first determining whether the plurality of primitives have a first direction;

generating first data information based on a result of the first determining;

second determining whether the plurality of primitives have a second direction opposite the first direction; and

generating second data information based on a result of the second determining.

13. The method of claim 12, wherein the generating of the winding number comprises:

generating a primitive mask of each of the plurality of pixels depending on whether an imaginary line extending from each of the plurality of pixels in a third direction intersects with at least one of the plurality of primitives; and

performing an arithmetic operation using the primitive mask, the first data information, and the second data information to generate the winding number.

14. The method of claim 13, wherein the third direction is perpendicular to each of the first direction and the second direction.

15. The method of claim 13 or claim 14, wherein the primitive mask, the first data information, and the second data information have a bit number corresponding to the number of plurality of primitives,

wherein the performing of the arithmetic operation using the primitive mask, the first data information, and the second data information comprises:

performing a first comparison operation between bits corresponding to the primitive mask and bits corresponding to the first data information;

performing a second comparison operation between bits corresponding to the primitive mask and bits corresponding to the second data information; and

generating the winding number using a result of the first comparison operation and a result of the second comparison operation.

16. The method of claim 11 or claim 12, wherein the graphics processing apparatus includes a storage circuit used to perform an arithmetic operation for generating the winding number, and

wherein the generating of the primitive direction information comprises storing the primitive direction information in a predetermined storage area of the storage circuit.

17. The method of any one of claims 11 to 16, wherein the graphics processing apparatus includes a storage circuit comprising an N-bit storage area configured to store the primitive direction information, wherein N is an integer equal to or more than 1, and

wherein the path data is pre-processed such that the number of plurality of primitives in the path corresponding to the path data is N or less.

18. The method of any one of claims 11 to 16, wherein the graphics processing apparatus comprises a storage circuit comprising the storage area configured to store the primitive direction information,

wherein the storage area is an N-bit storage area, and

wherein the method further comprises:

determining whether the number of plurality of primitives in the path exceeds N; and

performing the pre-processing operation on the path data to adjust the number of plurality of primitives to N or less based on a result of the determining whether the number of plurality of primitives in the path exceeds N.

19. A computing device comprising:

a central processing unit (CPU) configured to generate path data corresponding to a path in a frame;

a graphics processing unit (GPU) configured to receive the path data and perform a rendering operation based on the path data; and

a GPU local memory configured to store a rendering program, wherein the rendering operation is performed by the GPU based on the rendering program,

wherein the GPU comprises a register file comprising a plurality of registers,

wherein the GPU is further configured to:

determines a direction of a plurality of primitives in the path based on the path data,

generate primitive direction information,

control to store the primitive direction information in the register file, and

generate a winding number of each of a plurality of pixels using the stored primitive direction information, and

wherein, when a number of plurality of primitives in the path exceeds a storable bit number of the register file, the GPU is further configured to perform a pre-processing operation on the path data to adjust the number of plurality of primitives to the storable bit number of the register file or to less than the storable bit number of the register file.