CLAIMS

1. A device for implementing an adaptive test of a subject's neurological state, comprising:

a processor, a memory, a display, and an input device;

wherein the memory contains processor executable instructions to perform a method of adaptively testing a subject's neurological state, comprising the steps of:

administering one or more seed questions;

obtaining one or more answer(s) to the one or more seed questions;

calculating a score value for each of a plurality of a latent subject traits from the answer(s) to each of the one or more seed questions;

the method comprising an adaptive test loop, comprising:

(a) selecting, based on at least one of the score values, one or more further questions from a bank of questions;

(b) administering the one or more further questions to the subject;

(c) updating the score values for each of the plurality of latent subject traits based on the answers to the one or more further questions; and

(d) determining whether a test completion criteria has been met;

wherein the method repeats steps (a) – (d) in sequence until the test completion criteria has been met, and provides an output of the test based on the score value which is indicative of the subject's neurological state.

2. The device of claim 1, wherein the score value is a latent trait ability score.

3. The device of either claim 1 or claim 2, wherein each of the further questions has an associated difficulty rating and an indication of relevancy to at least one of the plurality of latent subject traits, and wherein the selection of the one or more further questions is further based on one or both of the associated difficulty rating and the indication of relevancy to one or more latent subject traits.

4. The device of any preceding claim, including an initial step of determining a weighting value for each of the plurality of latent subject traits, wherein selecting one or more further questions is further based on the weighting value for at least one of the plurality of latent subject traits.

5. The device of any preceding claim, wherein the plurality of latent subject traits include one or more of: cognitive trait, dementia trait, and depression trait.

6. The device of any preceding claim, wherein the score for the or each latent subject trait is calculated using an expectation maximisation algorithm and/or a generalised linear model.

7. The device of claim 6, wherein the generalised linear model has the form:

$$Y_{i,q} \sim \text{Bernoulli}(\alpha + \beta_q cog_i + \gamma_q dem_i + \delta_q dep_i)$$

where, $Y_{i,q}$ is the response given by the subject at a particular visit i, q is the question, α is the intercept, β_q, γ_q, and δ_q are difficulty scores for the questions associated with the cognitive trait, dementia trait, and depression trait respectively, and cog_i , dem_i, and dep_i are the subject ability score associated with the cognitive trait, dementia trait, and depression trait respectively.

8. The device of any preceding claim, wherein:

the seed questions and/or the further questions are selected from any one or more of the Alzheimer's Disease Assessment Scale-cognitive test, Alzheimer's Disease Cooperative Study – Activities of Daily Living test, Neuropsychiatric Inventory test, Montgomery-Asberg Depression Rating Scale test, and the Mini-Mental State Examination test; and/or

the seed questions and/or the further questions are used to calculate and update a score value for each of a plurality of latent subject traits.

9. The device of any preceding claim, wherein selecting one or more further questions is further based on an information content for each question in a database of questions, wherein the information content for each question in the database of questions is calculated for the subject based on the score value of the latent subject trait, and one or more questions from the database of questions with the highest information content is selected.

10. A computer program comprising code, which when run on a computer, causes the computer to perform a method of adaptively testing a subject's neurological state, comprising the steps of:

presenting one or more seed questions on a display;

receiving answers to the one or more seed questions via an input device;

calculating, by a processor, a score value for each of a plurality of latent subject traits

from the received answers to the one or more seed questions;

entering an adaptive test loop, comprising the steps of:

(a) selecting, based on at least one of the score values, one or more further questions from a database of questions;

(b) presenting the one or more further questions on the display;

(c) updating the score values for each of the plurality of latent subject traits based on received answers to the one or more further questions; and

(d) determining whether a test completion criteria has been met;

wherein the computer implemented method repeats steps (a) – (d) in sequence until the test completion criteria has been met, and provides an output of the test based on the score value which is indicative of the subject's neurological state.

11. The computer program of claim 10, wherein the score value is a latent trait ability score.

12. The computer program of either claim 10 or claim 11, wherein each of the further questions has an associated difficulty rating and an indication of relevancy to at least one of the one or more latent subject traits, and wherein selecting the one or more further questions is further based on one or both of the associated difficulty rating and the indication of relevancy to one or more latent subject traits.

13. The computer program of any of claims 10 – 12, including an initial step of determining a weighting value for each of the three latent subject traits, wherein selecting one or more further questions is further based on the weighting value for at least one of the plurality of latent subject traits.

14. The computer program of any of claims 10 – 13, wherein the plurality of latent subject traits include one or more of: cognitive trait, dementia trait, and depression trait.

15. The computer program of any of claims 10 – 14, wherein the score for the or each latent subject trait is calculated using an expectation maximisation algorithm and/or a generalised linear model.

16. The computer program of claim 15, wherein the generalised linear model has the form:

$$Y_{i,q} \sim \text{Bernoulli}(\alpha + \beta_q cog_i + \gamma_q dem_i + \delta_q dep_i)$$

where, $Y_{i,q}$ is the response given by the subject at a particular visit i, q is the question, α is the intercept, β_q, γ_q, and δ_{q} are difficulty scores for the questions associated with the cognitive trait, dementia trait, and depression trait respectively, and cog_i , dem_i, and dep_i are the subject ability score associated with the cognitive trait, dementia trait, and depression trait respectively.

17. The computer program of any of claims 10 – 16, wherein:

the seed questions and/or the further questions are selected from any one or more of the Alzheimer's Disease Assessment Scale-cognitive test, Alzheimer's Disease Cooperative Study – Activities of Daily Living test, Neuropsychioatric Inventory test, Montgomery-Asberg Depression Rating Scale test, and the Mini-Mental State Examination test; and/or

the seed questions and/or the further questions are used to calculate and update a score value for each of a plurality of latent subject traits.

18. The computer program of any of claims 10 - 17, wherein selecting one or more further questions is further based on an information content for each question in the database of questions, wherein the information content for each question in the database of questions is calculated for the subject based on the score value of the latent subject trait, and one or more questions from the database of questions with the highest information content is selected.

19. A computer readable storage medium storing a computer program comprising code which, when run on a computer, causes the computer to perform a method of adaptively testing a subject's neurological state, comprising the steps of:

presenting one or more seed questions on a display;

receiving answers to the one or more seed questions via an input device;

calculating, by a processor, a score value for each of a plurality of latent subject traits from the received answers to the one or more seed questions;

entering an adaptive test loop, comprising the steps of:

(a) selecting, based on at least one of the score values, one or more further questions from a database of questions;

(b) presenting the one or more further questions on the display;

(c) updating the score values for each of the plurality of latent subject traits based on received answers to the one or more further questions; and

(d) determining whether a test completion criteria has been met;

wherein the method repeats steps (a) – (d) in sequence until the test completion

criteria has been met, and provides an output of the test based on the score value which is indicative of the subject's neurological state.