

What is claimed is:

1. A computer-implemented method for analyzing an image corresponding to a specimen, the method comprising:

receiving a target electronic image corresponding to a target specimen, the target specimen comprising a tissue sample of a patient;

applying a machine learning system to the target electronic image to identify a region of interest of the target specimen and determine an expression level of, category of, and/or presence of a biomarker in the region of interest, the biomarker comprising at least one from among an epithelial growth factor receptor (EGFR) biomarker and/or a DNA mismatch repair (MMR) deficiency biomarker, the machine learning system having been generated by processing a plurality of training images to predict whether a region of interest is present in the target electronic image, the training images comprising images of human tissue and/or images that are algorithmically generated; and

outputting the determined expression level of, category of, and/or presence of the biomarker in the region of interest.

2. The computer-implemented method of claim 1, wherein the identifying the region of interest of the target specimen comprises dividing the target electronic image into one or more sub-regions, and determining whether a region of interest is present in any of the one or more sub-regions.

3. The computer-implemented method of claim 1, wherein the identifying the region of interest of the target specimen comprises:

dividing the target electronic image into one or more sub-regions using at least one of creating tiles of the target electronic image, segmenting the target electronic image based on

edge and/or contrast, segmenting the target electronic image using color differences, and/or supervised determination; and

determining whether a region of interest is present in any of the one or more sub-regions.

4. The computer-implemented method of claim 1, further comprising:

dividing the target electronic image into one or more sub-regions by creating tiles of the target electronic image; and

determining an expression level of, category of, and/or presence of a biomarker in a region of interest by determining a first expression score for each tile of the target electronic image, and aggregating the first expression score for each of the tiles to determine a second expression score for part of the target specimen.

5. The computer-implemented method of claim 1, wherein the determining of the

expression level of, category of, and/or presence of a biomarker in the region of interest comprises determining a probability that there is a presence of the biomarker in the region of interest.

6. The computer-implemented method of claim 1, wherein the determining of the

expression level of, category of, and/or presence of a biomarker in the region of interest comprises:

grouping expression levels into one or more diagnostic categories, the one or more diagnostic categories representing a scale of a presence of the biomarker in the region of interest; and

identifying a diagnostic category, among the one or more diagnostic categories, to classify the biomarker in the region of interest.

7. The computer-implemented method of claim 1, wherein the outputting the determined expression level of, category of, and/or presence of the biomarker in the region of interest comprises displaying a visual indicator for the expression level of, category of, and/or presence of the biomarker, and displaying one or more treatment options based on the expression level of, category of, and/or presence of the biomarker.

8. A system for analyzing an image corresponding to a specimen, the system comprising:

at least one memory storing instructions; and

at least one processor configured to execute the instructions to perform operations comprising:

receiving a target electronic image corresponding to a target specimen, the target specimen comprising a tissue sample of a patient;

applying a machine learning system to the target electronic image to identify a region of interest of the target specimen and determine an expression level of, category of, and/or presence of a biomarker in the region of interest, the biomarker comprising at least one from among an epithelial growth factor receptor (EGFR) biomarker and/or a DNA mismatch repair (MMR) deficiency biomarker, the machine learning system having been generated by processing a plurality of training images to predict whether a region of interest is present in the target electronic image, the training images comprising images of human tissue and/or images that are algorithmically generated; and

outputting the determined expression level of, category of, and/or presence of the biomarker in the region of interest.

9. The system of claim 8, wherein the identifying the region of interest of the target specimen comprises dividing the target electronic image into one or more sub-regions, and determining whether a region of interest is present in any of the one or more sub-regions.

10. The system of claim 8, wherein the identifying the region of interest of the target specimen comprises:

dividing the target electronic image into one or more sub-regions using at least one of creating tiles of the target electronic image, segmenting the target electronic image based on edge and/or contrast, segmenting the target electronic image using color differences, and/or supervised determination; and

determining whether a region of interest is present in any of the one or more sub-regions.

11. The system of claim 8, further comprising:

dividing the target electronic image into one or more sub-regions by creating tiles of the target electronic image; and

determining an expression level of, category of, and/or presence of a biomarker in a region of interest by determining a first expression score for each tile of the target electronic image, and aggregating the first expression score for each of the tiles to determine a second expression score for part of the target specimen.

12. The system of claim 8, wherein the determining of the expression level of, category of, and/or presence of a biomarker in the region of interest comprises determining a probability that there is a presence of the biomarker in the region of interest.

13. The system of claim 8, wherein the determining of the expression level of, category of, and/or presence of a biomarker in the region of interest comprises:

grouping expression levels into one or more diagnostic categories, the one or more diagnostic categories representing a scale of a presence of the biomarker in the region of interest; and

identifying a diagnostic category, among the one or more diagnostic categories, to classify the biomarker in the region of interest.

14. The system of claim 8, wherein the outputting the determined expression level of, category of, and/or presence of the biomarker in the region of interest comprises displaying a visual indicator for the expression level of, category of, and/or presence of the biomarker, and displaying one or more treatment options based on the expression level of, category of, and/or presence of the biomarker.

15. A non-transitory computer-readable medium storing instructions that, when executed by processor, cause the processor to perform a method for analyzing an image corresponding to a specimen, the method comprising:

receiving a target electronic image corresponding to a target specimen, the target specimen comprising a tissue sample of a patient;

applying a machine learning system to the target electronic image to identify a region of interest of the target specimen and determine an expression level of, category of, and/or

presence of a biomarker in the region of interest, the biomarker comprising at least one from among an epithelial growth factor receptor (EGFR) biomarker and/or a DNA mismatch repair (MMR) deficiency biomarker, the machine learning system having been generated by processing a plurality of training images to predict whether a region of interest is present in the target electronic image, the training images comprising images of human tissue and/or images that are algorithmically generated; and

outputting the determined expression level of, category of, and/or presence of the biomarker in the region of interest.

16. The non-transitory computer-readable medium of claim 15, wherein the identifying the region of interest of the target specimen comprises dividing the target electronic image into one or more sub-regions, and determining whether a region of interest is present in any of the one or more sub-regions.

17. The non-transitory computer-readable medium of claim 15, wherein the identifying the region of interest of the target specimen comprises:

dividing the target electronic image into one or more sub-regions using at least one of creating tiles of the target electronic image, segmenting the target electronic image based on edge and/or contrast, segmenting the target electronic image using color differences, and/or supervised determination; and

determining whether a region of interest is present in any of the one or more sub-regions.

18. The non-transitory computer-readable medium of claim 15, further comprising:

dividing the target electronic image into one or more sub-regions by creating tiles of the target electronic image; and

determining an expression level of, category of, and/or presence of a biomarker in a region of interest by determining a first expression score for each tile of the target electronic image, and aggregating the first expression score for each of the tiles to determine a second expression score for part of the target specimen.

19. The non-transitory computer-readable medium of claim 15, wherein the determining of the expression level of, category of, and/or presence of a biomarker in the region of interest comprises determining a probability that there is a presence of the biomarker in the region of interest.

20. The non-transitory computer-readable medium of claim 15, wherein the determining of the expression level of, category of, and/or presence of a biomarker in the region of interest comprises:

grouping expression levels into one or more diagnostic categories, the one or more diagnostic categories representing a scale of a presence of the biomarker in the region of interest; and

identifying a diagnostic category, among the one or more diagnostic categories, to classify the biomarker in the region of interest.