**DPATH Breast Tumor Annotation:**

Slide Label Classifications

by Julien Simons

Disclaimer: These notes and resulting annotations are not clinically nor professionally acceptable outside of providing pilot data to machine learning algorithms. We are lucky to have patient reports, so we can more easily label cancerous regions within our HIPAA contract. This information is our own, produced from the generous teachings of Dr. Jhala, Director of Anatomic Pathology and Cytology at Temple University Hospital. Our annotations would need to be revisited and corrected to be more accurate and include other desirable features if we want this to be used in a higher setting.

1. Normal (**norm**): Normal is represented by groupings of circular lobules or an ovular duct. Within their cell wall (epithelium), lobules and ducts include a generally empty space called the lumen. The lining of the lumen of the healthiest lobules and ducts is held together; nothing is falling apart nor falling inside the lumen.
2. Background (**bckg**): Background is made up of stroma or pink stained tissue. Blood cells and fatty tissue are included within background. Blood cells are extremely pink and ovoid-shaped. Fat is represented by a large, web-like network of tissue, usually on the outer lining of the tissue sample. Keep in mind that the edges of the tissue sample were cut in a way that damaged the stroma. This is represented by a crust-like shape and darker colors ranging from brown, blue, and purple.
3. Null (**null**): Null or indistinguishable tissue is often a result of cutting the sample, resulting in noticeable tissue damage of a normal lobule or duct, not just background. This is often noticed along the edges of a sample from where the tissue was cut. However, it can sometimes also be noticed within the tissue either as a result of a poor cut of the slide sample, or it was done in a way that pathologists had micro-sampled that given lobule or duct of interest before the slide was made. (All null cases should be classified by machine learning as background. But, null should remain its own label similar to normal cell regions (norm) due to their higher similarity to cancer-like regions. In doing so, the classification system will work more precisely by measuring normal and null cases respectively both with stronger correlation to cancer than a background region.)
4. Artifact (**artf**): Artifact regions consist of grease pen marks, stitches, or unfocused scratches on the slide. Sometimes an unfocused, small black particle, likely dust, is on the slide. Due to being so small, just ignore it.
5. Inflammation (**infl)**: Inflammation is represented by a high concentration of small dots spread across a small area. The concentration of dots reduces through space, instead of due to a wall of a container. These dots can be moving freely through the stroma (pink tissue) or reside along the edges (cell wall) of a container (lobule or duct).
6. Non-neoplastic (**nneo**): Non-neoplastic label consists of two features, fibrosis and hyperplasia, often also accompanied by inflammation. Some of these may develop into cancer while others are simply benign. The specifics would be better answered by pathologists.

A. Fibrocystic changes occur when the lumen within the cell expands substantially, creating a cyst.

* It maintains a circular shape while causing the cell wall lining of the lobule to thin.
* It can include calcifications represented as a small, somewhat circular, dense, very dark, and purple-colored area of cells.

B. Hyperplastic changes occur when the cell wall lining grows and takes up the lumen, so that there is little or no white space within.

* An additional feature of this change is represented by mushroom-like, irregular expansions of the cell.
* Furthermore, hyperplasia can be classified with elongated, ovoid-shaped nuclei (dot-like particles) within the cell wall lining.
* Lastly, noticing two cell layer linings instead of one within the epithelial cell wall of the lobule or duct can be another sign.
1. Suspicious (**susp**): These regions are suspected of being or showing early onset of DCIS, IDC, non-neoplastic, other harmful, uncategorized, or non-normal tissue. They should have inflammation in and around the region. Therefore, these regions are unknown and can be relabeled at a later date with the help of pathologists. However, sometimes pathologists are also unsure of these regions (sometimes marked by a grease pen) and may contact a Tumor Board.
2. Ductal Carcinoma In Situ (**dcis**): This is classified as cancer. It is a large, enclosed, dense, purple, and usually more darkly contrasted region filled with many nuclei (dots). The cancerous nuclei are duplicating, further expanding the tumorous lobules (similar to hyperplasia) and what remains of ducts which can become a large vein-like region. Inflammatory cells (look just like nuclei) are evident within and residing outside the cancerous region. Refer first to the patient report if available before annotating for cancer.
3. Invasive Ductal Carcinoma In Situ (**indc**): This is also classified as cancer. Instead of originating in the lobules and ducts, it "invades" the stroma, background tissue, so it is not bound by a container. Its defining structure normally appears to be made up of a free-formed, interconnected network of small, spherical, thinly walled, and translucent cells with a nucleus in each, often with inflammation spread through it as well. Refer first to the patient report if available before annotating for cancer.