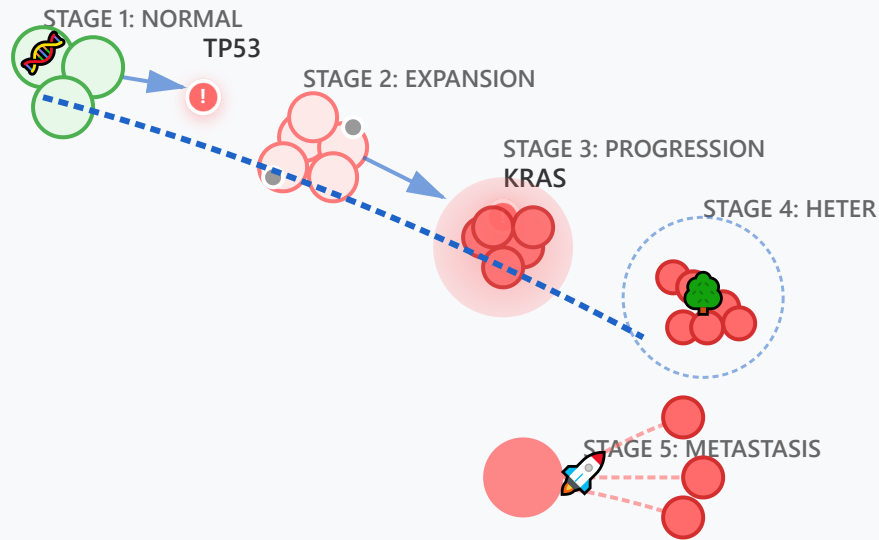


# Cancer Genomics



## Driver Mutations

Mutations providing selective growth advantage to cancer cells



## Passenger Mutations

Neutral mutations accumulated during tumor evolution



## Clonal Evolution

Tumor progression through sequential genetic changes



## Tumor Heterogeneity

Genetic diversity within and between tumors

Minimal Residual Disease: Ultra-sensitive detection of remaining cancer cells post-treatment



## Multi-Hit Hypothesis

Cancer develops through accumulation of multiple genetic alterations over time. Each driver mutation (TP53, KRAS) provides



## Branched Evolution

Tumors evolve as branching trees with trunk mutations (shared by all cells) and branch mutations (specific to subclones). This creates

incremental growth advantages, leading to progressive transformation from normal to malignant cells.

intratumor heterogeneity with different genetic profiles in various tumor regions.



### **Selection Pressure**

Cancer cells undergo Darwinian selection where driver mutations conferring survival advantages are positively selected, while passenger mutations hitchhike neutrally through clonal expansion.



### **Metastatic Cascade**

Metastasis requires additional genetic changes enabling invasion, survival in circulation, and colonization of distant organs. These late-stage mutations represent the most aggressive cancer phenotypes.