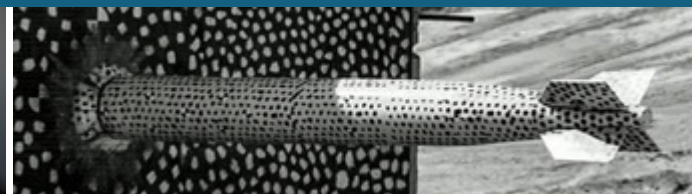
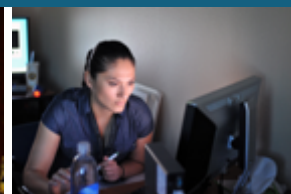
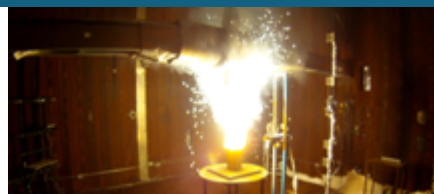




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Preliminary Work on a Digital Twin for Cancer Patients



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Joint work with:

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Digital Twin for Cancer Patients: Overview



Background:

- Many treatment plans available to cancer patients
- Selection, ordering, and other details dependent on individual patient
- Time is important
- Digital twin development effort a collaboration between NCI and DOE

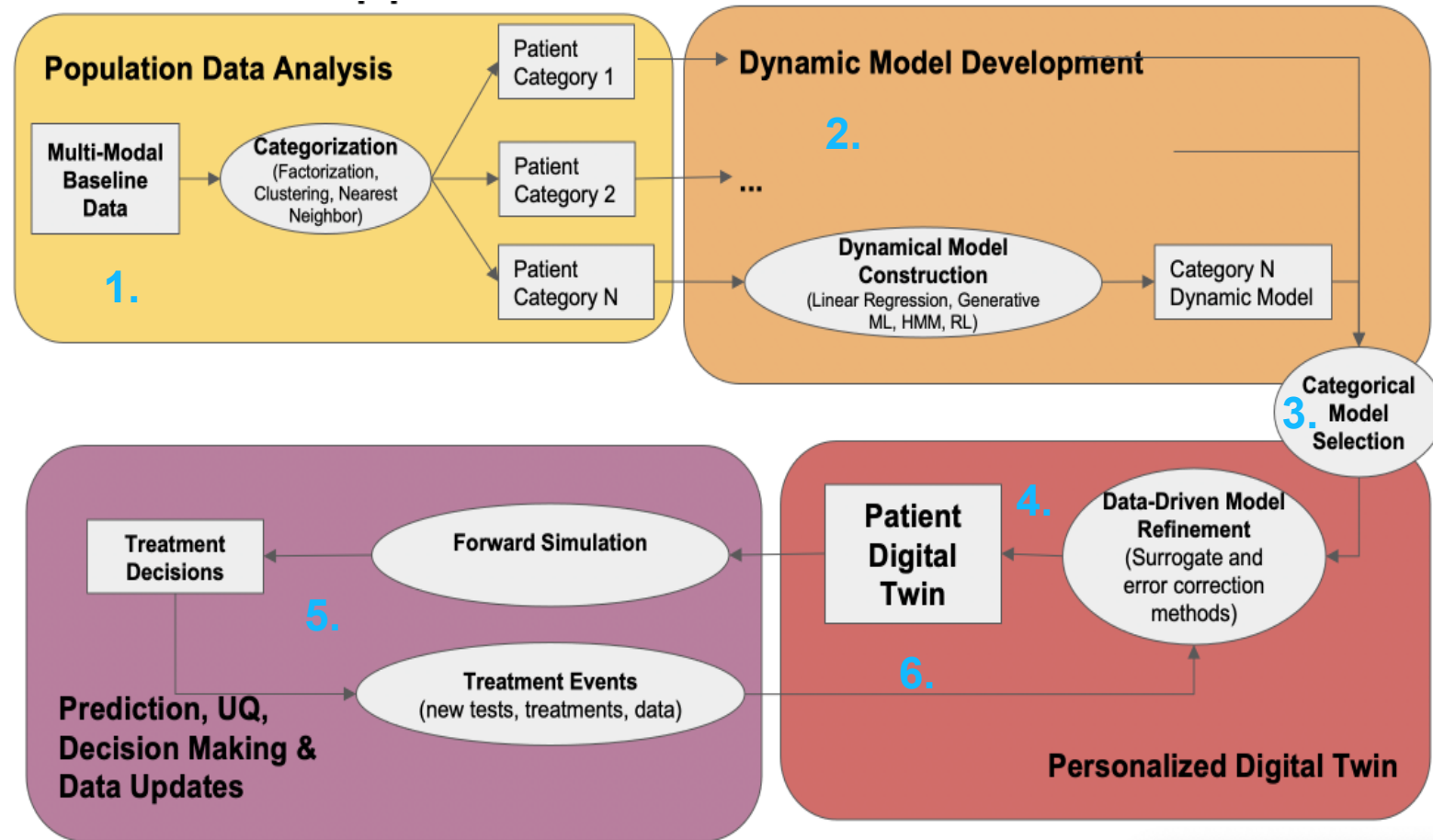
Goal:

- Identify optimal treatment strategy for individual patients
- Develop a patient model to determine specific outcomes, including response to individual treatments (response, resistance, side effects, etc)
- Reduce guesswork and speculation in cancer treatment
- Ultimately support development of new treatment options



3 Technical Approach: Divide and Conquer

1. Separate individuals into categories
 - **Goal:** Simplify modeling
 - **Challenges:** incompleteness, dimensionality, interpretation tradeoff
2. Construct dynamical models
 - **Goal:** “Eigenpatient” models
 - **Challenges:** Data coarseness, induction “physics,” multiobjective optimization
3. Select model for individual
 - **Goal:** Place patient into category
 - **Challenges:** Noise & uncertainty
4. Personalize dynamical model
 - **Goal:** Specialize selected model
 - **Challenges:** #2 – with less data
5. Simulate and predict
 - **Goal:** Estimate treatment effects
 - **Challenges:** Interaction with treatment team, decision analysis
6. Iterate steps 4 and 5.



Selected Fundamental Research Needs and Challenges



- What data properties are needed to support digital twin construction?
 - Collection frequency
 - Test completeness
 - Breadth of data
 - Number of individuals
- What's the impact of available physics on data requirements?
- To what degree can we automate induction (and revision) of dynamical models?
- Can we capture the space of all possible interventions in a single model?
- Given the interdependencies among the major components of the proposed approach, what starting points allow us to validate progress?