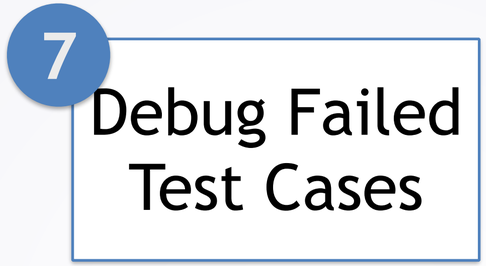
Finding Bugs in Code

Applying the Scientific Method

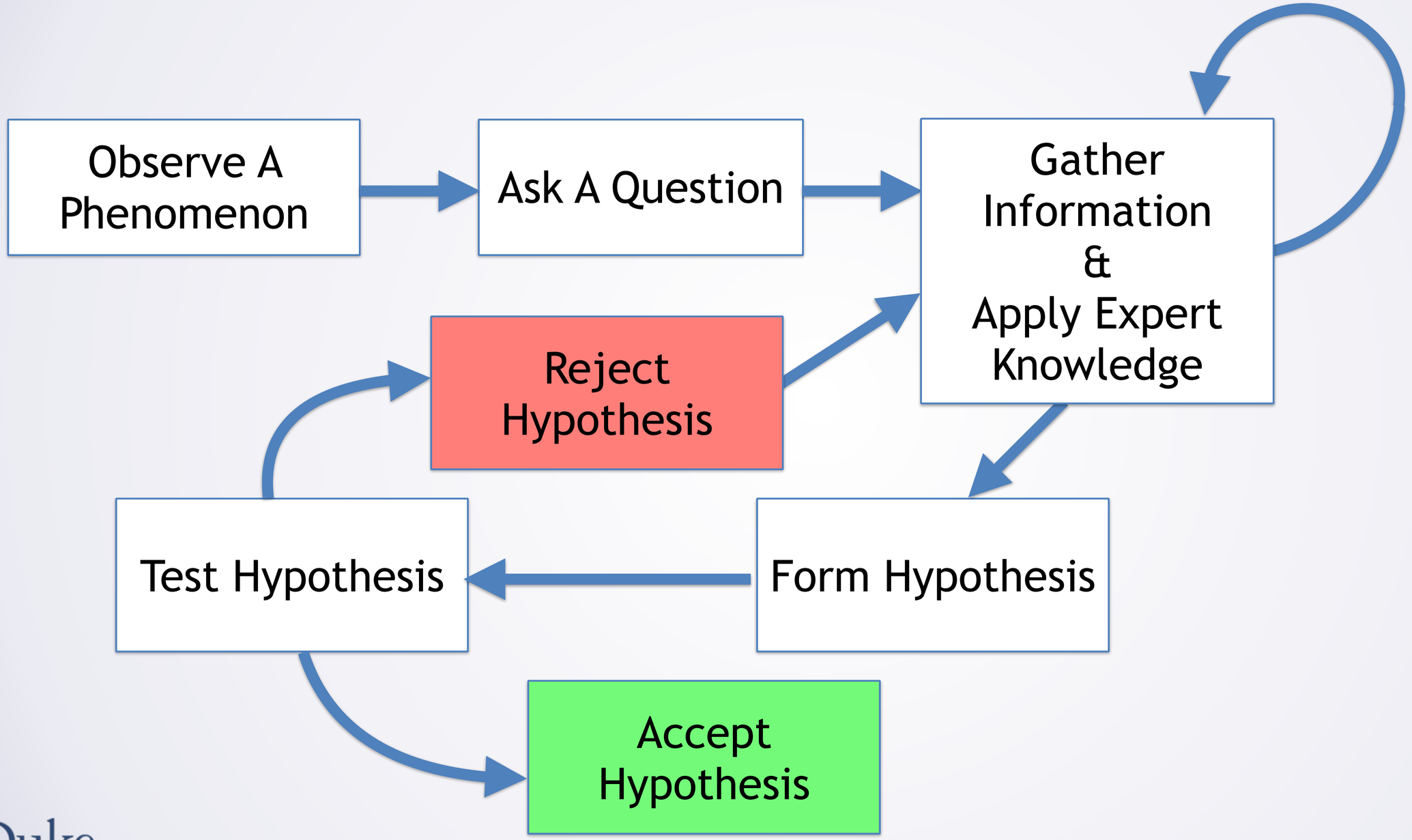
Duke
UNIVERSITY

Finding and Fixing Bugs



- Step 7: Debug Failed Test Cases
  - How do you do this?
  - Use scientific method

Scientific Method



Gathering Information

- How do we gather info?
  - Print statements
  - Debugging tools
  - Execute code by hand
- Expert Knowledge
  - Comes with experience

Hypotheses

- Good hypotheses are
  - Testable
    - Prediction about behavior
  - Actionable
    - Can fix program if true
- Being specific helps with both

Hypotheses

Example (no useful information):

“My program is broken”

Hypotheses

Example (better):

“The problem is on line 5”

Hypotheses

Example (even better):

“The problem is division by zero on line 5”

Hypotheses

Example (very good):

"The problem is division by zero on line 5, when an input pixel has red < 30 and green > 245"

Testable

Actionable

Testing Hypotheses

- Run program
- Behavior matches predictions?
  - **No: reject hypothesis**
  - **Yes: more confident**
    - Confident enough? Accept
- Checking: similar to gather info

Temptation: Ad Hoc Changes

- Temptation: “maybe if I just change…”
  - Just tweak some code—maybe will fix it?
  - Maybe get lucky? Save some time…
  - Tempting, but poor idea.
- Metaphor: medical doctors
  - Suppose you were ill
  - Visit doctor to diagnose you
  - Does the doctor randomly try things?
    - If so, get a new doctor!
  - No! The doctor uses the scientific method

Scientific Method