Announcements

- P3 specification typo
  - Changed on webpage
- Quiz 3 tomorrow
- P5 will be posted on Friday
- “Any checked exception must be surrounded with try-catch”
  - Unless the `throws` keyword is used

Bugs

Outcomes that do not match expectations.

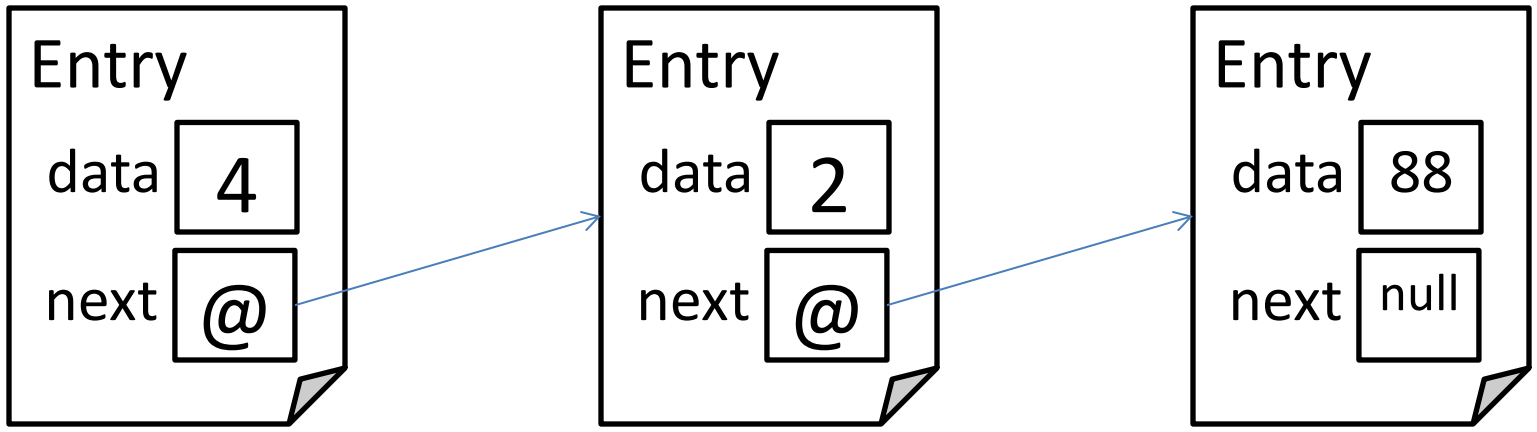
```
isPrime(11) → false
isComposite(11) → true
inBase(2013,10) → “02013”
inBase(0,10) → “”
rollBiasedDie() → NullPointerException
```

Debugging: Identifying the cause of the mismatch and fixing it.

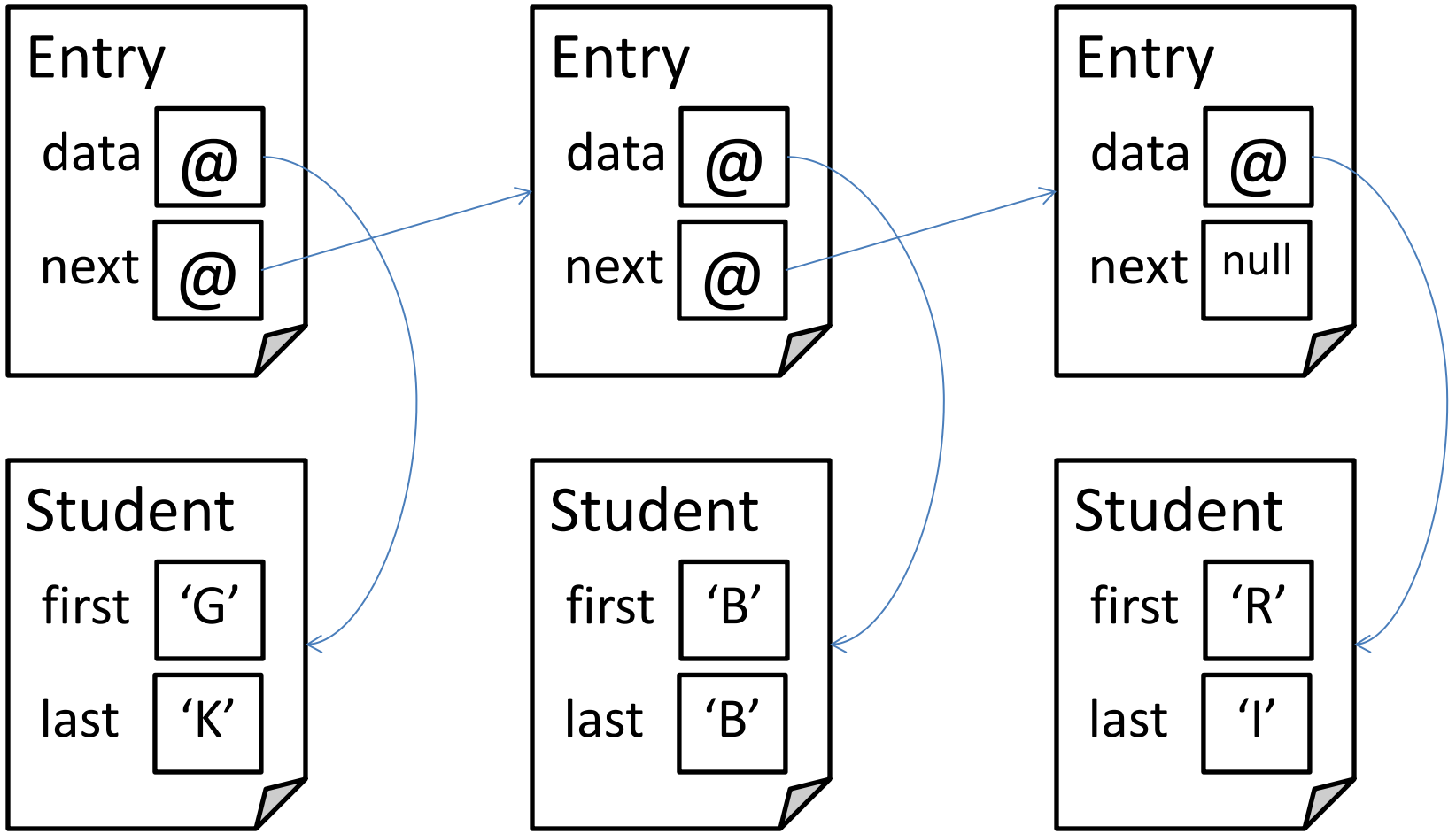
Manual debugging

- Printing additional information to the console
  - Tedious
  - Hard-coded
  - Floods the console
  - Takes experience – rollBiasedDie example
    - A single well-placed print can reveal the bug
- Tracing your code mentally or by hand
  - Tedious
  - Error-prone
  - Flexible and Intuitive – IntList example

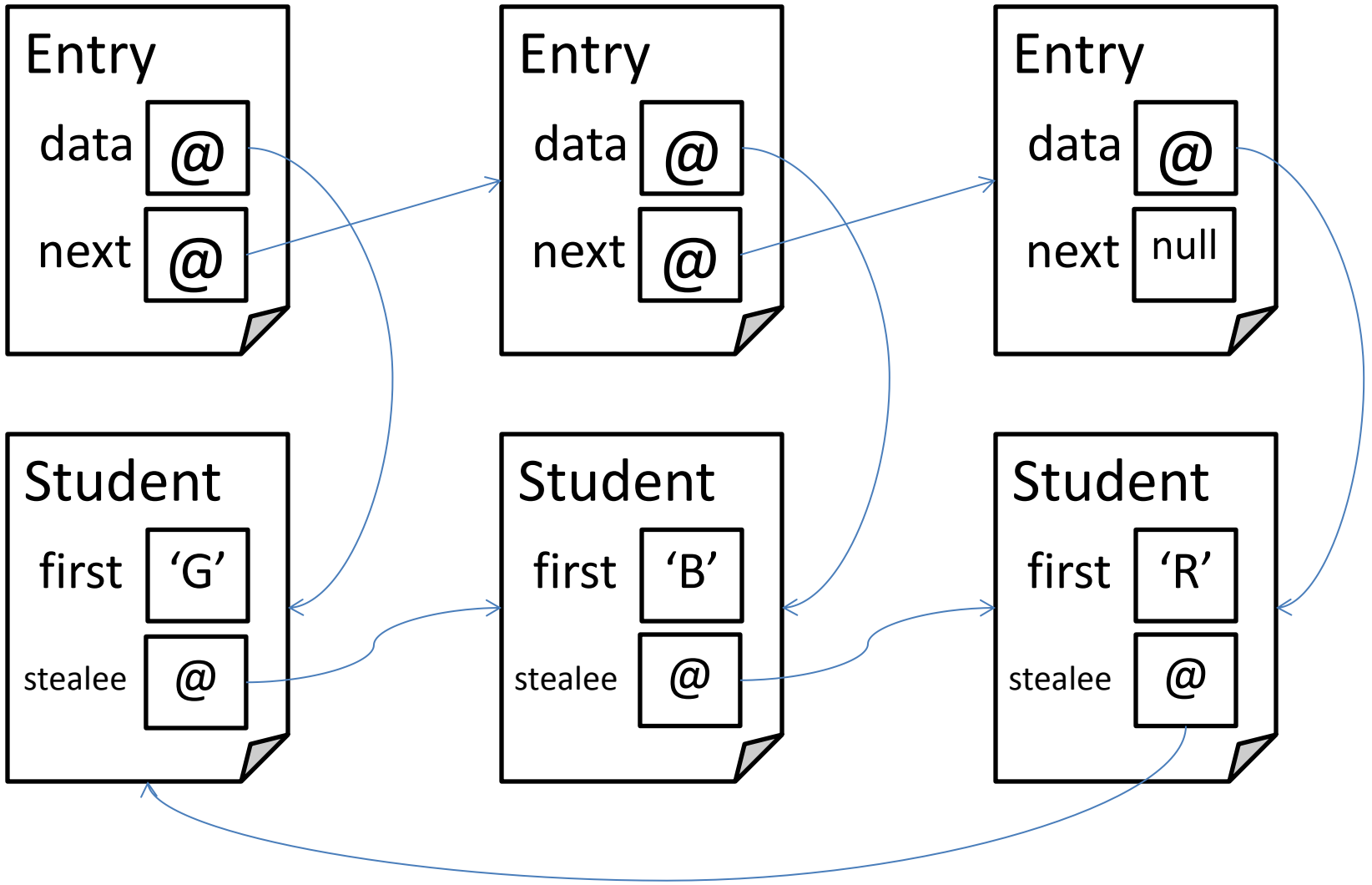
IntList



StudentList



With Stealees



Debuggers

- Automated
- Fast
- Error-free
- User-friendly?
- Also take experience

Debugger Concepts

- Break-points
  - Execution will flow normally until encountering a break-point
  - At a break-point, execution hangs until the user chooses to continue
  - The user chooses the break-points
    - Can be activated/inactivated during execution
    - “Hit counts”: Break-point must be encountered a certain number of times before activating

Debugger Concepts

- Stepping
  - To the next line of code
  - “Into” a method call
    - Go to method code and continue line by line
  - “Over” a method call
    - Execute method call without pause
    - Active break-points take precedence
  - “Out of” a method call
    - The remainder of the method is executed without pause

Debugger Concepts

More esoteric concepts: http://www.vogella.com/articles/EclipseDebugging/article.html

- Watch-points
  - Placed on variables, rather than executable commands
  - Whenever the variables are accessed or modified, the execution pauses for user-input
- Conditional break-points
  - Only pause execution when an additional condition (in the form of a user-provided code snippet) is met
- Manual intervention
  - Variables can be manually overwritten by the user mid-execution

Debugging examples

- Primates, Dogs, Bugs
- isPrime/isComposite
- inBase

More on Static data/methods

- Constructors and null
  - Constructor returning null?
  - Passing null to copy constructor?
- Inserting into empty list?

More on Static data/methods

- Static “factory methods” to replace constructors
  - Descriptive naming
    - Different names with same parameters
  - Null handling
  - Recycling existing allocations
- `import static somePackage.SomeClass.*;`
  - Makes static members directly accessible

More on initializing fields

- Default initial values for fields (static or instance):
  - Numeric primitives: zero
  - Booleans: false
  - Chars: ‘ ‘
  - Reference variables: null
- Over-riding defaults values
  - Instance fields can be initialized when declared, they do not need to be initialized in every constructor
  - If final fields are initialized in every constructor, they do not need to be initialized when declared
- Local variables in methods (not static or instance fields) are not initialized by default.