Open Discussion

- Minute essay comments:
  - How do you make multiple buttons press when one is pressed?
  - I don't do reddit.
  - Nesting of components (and code).
  - How long until iRobot?
  - What did I do during my sabbatical?
  - How to notice things like missing )?
  - What is my favorite dragon?
  - Layout vs. contents?
- Stigma of tracking.
- What car would I own?
- If you try to load an image that isn't there the program crashes.
Key Events

- There are three event types for keys.
  - KeyPressed
  - KeyReleased
  - KeyTyped

- Listen to the keys object in a component to get these.

- Compare the key value in the event to values in the Key object.
  - if(e.key==Key.A) …
  - if(e.key==Key.Left) …
Animations

- For animations and many other things we want code to happen at regular intervals.
- We can set this up with a javax.swing.Timer.
  - new Timer(delay: Int, ae: ActionListener)
  - Delay is in milliseconds.
  - Swing.ActionListener(handler: (ActionEvent) => Unit)
- The function body will be executed at the desired intervals.
Motivation

- There are many reasons that you might want the data you are working with to be in a particular order.
- If nothing else, humans often like seeing things in certain orders.
- It turns out that ordered data can be beneficial for the computer as well.
- Putting things in order by some value is called sorting.
Methods of Sorting

- If I ask you to sort a bunch of items, how would you go about doing it? Describe your approach.
- How does it vary for different types or configurations of objects?
We are going to look at three different sorting techniques today.

These sorts all do work that is proportional to the square of the number of elements.

That isn't good for large collections, but the sorts are fairly simple to write.

These work “in place” so we use arrays.

Each involves an inner loop that reorders things and an outer loop that makes the inner one happen over and over.
Bubble Sort

- **Inner loop:**
  - Compare adjacent elements and swap them if they are out of order.

- **Outer loop:**
  - Repeat n-1 times or until no swaps are done.
  - The latter option is called a flagged bubble sort.
This is often called a min-sort or a max-sort depending on how you write it. I'll describe a min-sort here.

Inner loop:
- Find the smallest element and SWAP it into position if not already there.

Outer loop:
- Repeat n-1 times so all elements are in the right place.

Does only $O(n)$ swaps, but still $O(n^2)$ comparisons.
Insertion Sort

- **Inner loop:**
  - Take the next element and shift it down to the right spot.

- **Outer loop:**
  - Run through all the elements starting with the second.

- This sort is actually a bit faster (factor of 2) on random data. It is really efficient on nearly sorted data.
One advantage of doing graphics before sorting is that we can write code to visualize what is happening when we sort numbers with these sorts.

Let's write this code and watch our sorts work.
Show me what would happen after each iteration of the inner loop if we min-sort these values.

- 4, 7, 1, 3, 8, 2