Lecture 3.7 – Debugging

Specific Learning Objectives:

1.2.1 – Understand the way computers execute commands.

1.2.11 – Use a conditional statement to add exception handling to a function or script.

1.3.9 – Learn basic skills in debugging and troubleshooting error messages.

1.3.10 – Search for effective solutions and tools using online resources.

3.5 – Think and work independently with code.

Learning How to Debug

- **Debugging** is the process of removing errors in code that cause it to malfunction.
    - This can include removing error messages or unintended/unexpected behavior or results.
    - Problem solving these issues is a skill that requires practice and a solid understanding of what is happening within your script and function.

- **Four General Strategies of Debugging:**

I. Check for the most common (i.e. “screaming toddler”) problems.

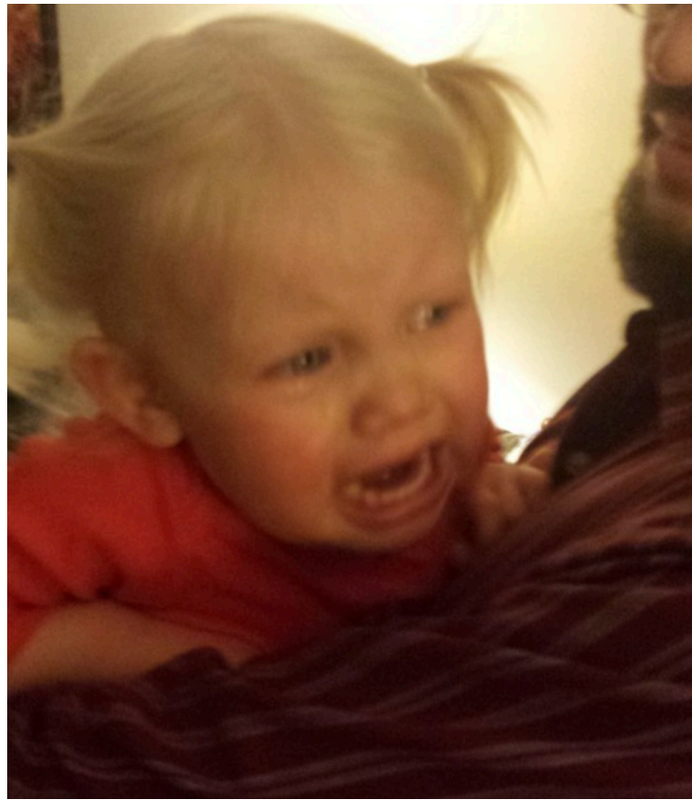
II. Figure out where the error is.

III. Google the error.

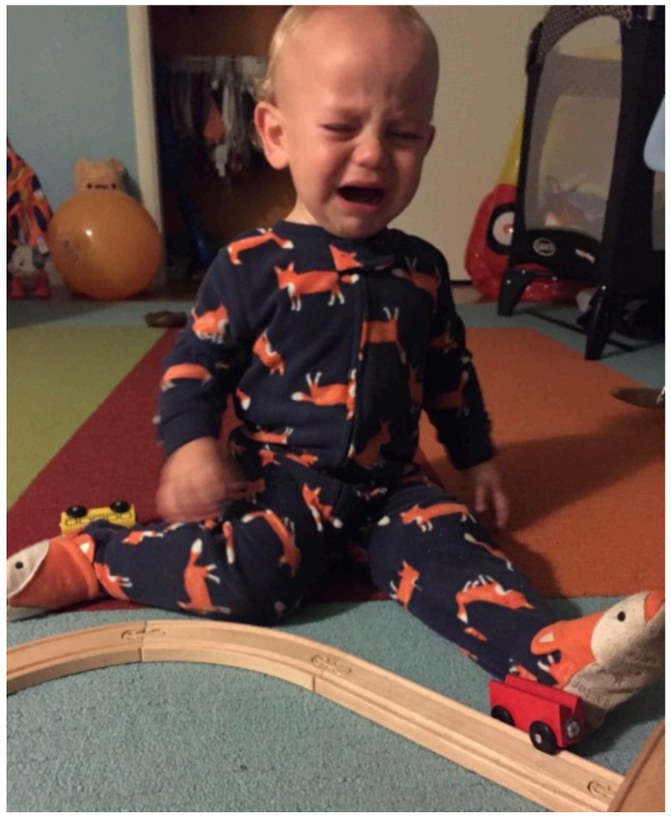
IV. Create a hypothesis and test it.

I. How R is like a toddler

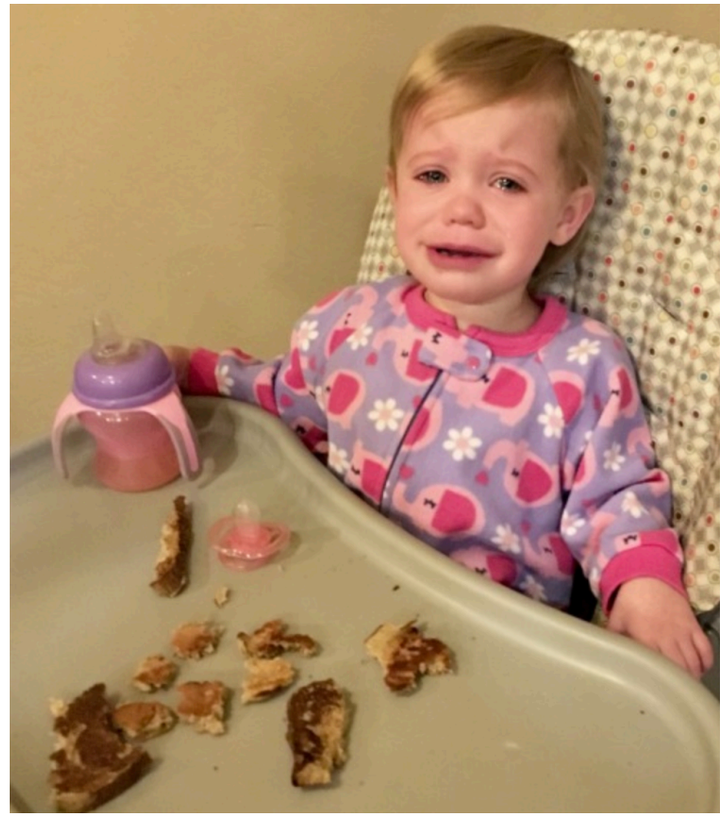
https://reasonsmysoniscrying.tumblr.com/



I ate a cracker she shoved into my mouth.



He shoved his train off the track.



I ripped her pancakes up into smaller pieces like she asked me to.

R will give you error messages that don't make sense and don't seem connected to the problem. It's like a toddler: it can tell you things, but those things aren't always useful to solving the problem at hand.

I. How R is like a toddler

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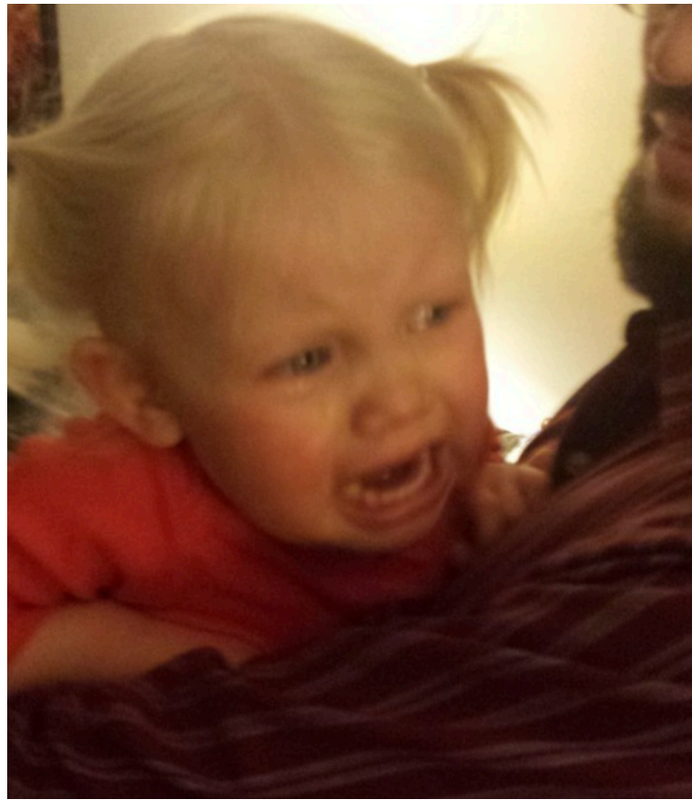

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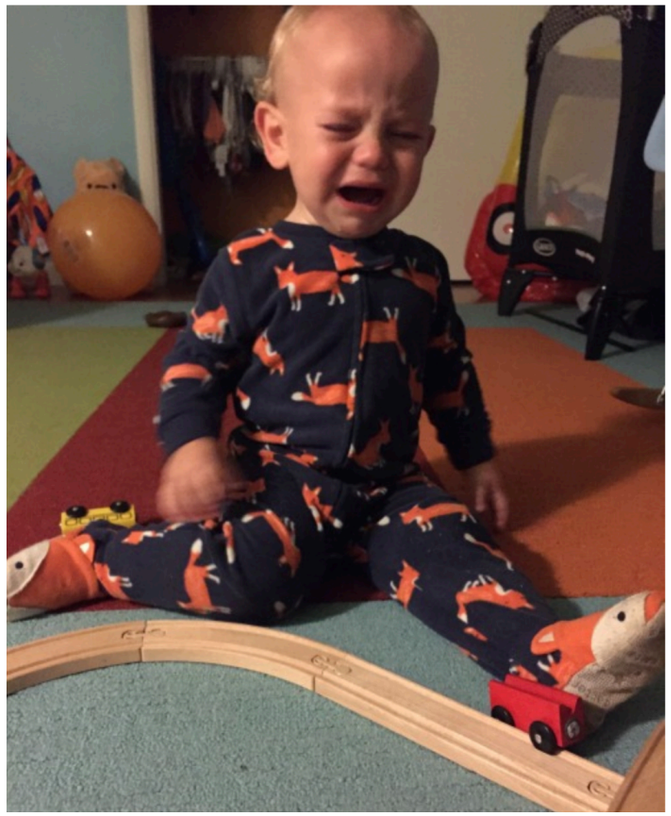

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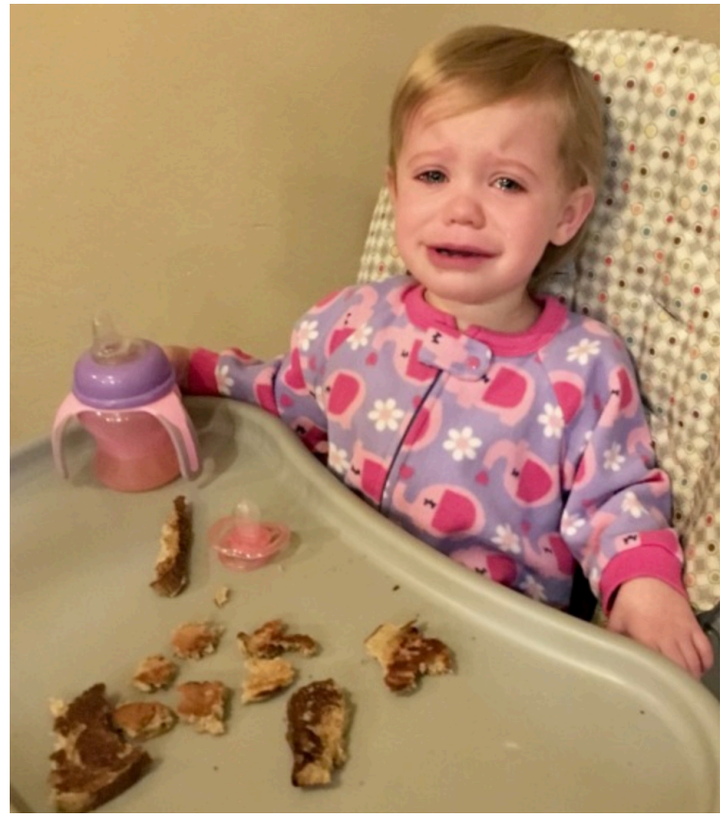

I ripped her pancakes up into smaller pieces like she asked me to.

Why is the toddler really screaming?

1. **They are hungry.**
2. **They are tired.**
3. **They have to potty.**

Why is R not working?

1. **It can’t find the object/function.**
2. **It’s using an unexpected value.**
3. **It wants a different data class.**

I. R's Screaming Toddler Problems

1. It can't find the object/function.

- Errors look like:

```
Error: object 'a' not found
```

```
Error in C("sum", "mean", "average") :
  object not interpretable as a factor
```

```
Error in file(file, "rt") : cannot open the connection
In addition: Warning message:
In file(file, "rt") :
  cannot open file 'data.csv': No such file or directory
```

```
Error in ggplot() : could not find function "ggplot"
```

- Try these things to fix it:
  - Check spelling
  - Check capitalization/case
  - Check working directory/location of file
  - Check to make sure object is in your "local" environment (is the package loaded? is your function including the right inputs?)

I. R's Screaming Toddler Problems

2. It's using an unexpected value.

- Errors look like:

```
Error in a[1, ] : object of type 'closure' is not subsettable
```

```
Error in b[, 1] : incorrect number of dimensions
```

```
> mean(1,32,25,2)
[1] 1
```

```
Error in sum(1, 2, 4, ) : argument 4 is empty
```

- Try these things to fix it:
  - Is R calling the object you think it is?
  - Clear your environment and try again.
  - Look closely at the arguments in a function, are you sure they are in the right order/the correct number?
  - Is the object the same size as what you're calling?

I. R's Screaming Toddler Problems

3. It wants a different data class.

- Errors look like:

```
Error in a[1, ] : object of type 'closure' is not subsettable
```

```
Error in b[, 1] : incorrect number of dimensions
```

```
Error in sum("a") : invalid 'type' (character) of argument
```

```
Error in C("sum", "mean", "average") :
  object not interpretable as a factor
```

- Try these things to fix it:
  - Is what you are doing to the object appropriate? (specifically indexing)
  - Is that the data type that a function wants as an input?
  - Look closely at the arguments in a function, are you sure they are in the right order/the correct number?

II. Figure Out Where the Error Is

- If it's not one of the most common problems, next step is to figure out where the error is and get more information about it.

  - **READ THE ERROR MESSAGE.** Even if it's not helpful, it will usually help you figure out what line the problem is at.

  - Use **`traceback()`**, this can help by identifying the lines in each environment that are throwing errors.

  - Use the script editor to help point out any syntax errors.

  - Trace back the error yourself by running a script line-by-line until you hit the error.

  - If inside a function, manually assign arguments and then step through line-by-line.

III. Google it

- The most helpful thing to do sometimes is to google an error message to see if someone else has already fixed it!

  - To maximize search results for success, don't include too much specific information about the error such as object names.

For example, you get this error:

```
Error in a[1, ] : object of type 'closure' is not subsettable
```

Don't google this object name, not many people will name objects "a"

Try googling the general statement

https://letmegooglethat.com/?q=object+of+type+%27closure%27+is+not+subsettable

IV. Create a Hypothesis and Test It

- After reading potential answers, form a hypothesis and figure out how to test it.

  - This will depend on the particular problem, but will almost always involve simply trying different things until both of these things happen:

    1. **The error goes away**
    2. **You understand the error**

```
Error in a[1, ] : object of type 'closure' is not subsettable
```

Google says don’t use square brackets, why?

Does taking away the square brackets fix the problem?

IV. Create a Hypothesis and Test It

- How do you test hypotheses inside functions?

In Class Exercises

1. **Debug the function!**

Action Items

1. **Complete previous assignments.**

2. **Read Davies Ch. 11 for next time.**