Lecture 9: Recursive Programming

07/13/22

Announcements

- A1 resubmission due Wednesday, July 13th @ 11:59pm
  - Tonight!
- A3 due Thursday, July 14th @ 11:59pm

Recursion and cases

Every recursive algorithm involves at least 2 cases:

- **base case**: the simplest case
- **recursive case**: does a tiny bit of work, then breaks down the problem into a smaller version of itself

Some recursive algorithms have more than one base or recursive case, but all have at least one of each.

Roadmap for the week

- Monday
  - Introduce idea of **recursion**
  - Goal: Understand idea of recursion and **read** recursive code
- Tuesday
  - Practice **reading** recursive code
- Wednesday
  - More complex recursive examples
  - Goal: Identify recursive structure in problem and **write** recursive code
- Thursday
  - Practice **writing** recursive code

```
// post: returns an integer where every digit of n is
// replaced by two of that digit.
// Example: doubleUp(348) returns 334488
// Example: doubleUp(-348) returns -334488
public static int doubleUp(int n) {
    if (n < 0) {
        return -doubleUp(-n);
    } else if (n < 10) {
        return n * 11;
    } else {
        return 100 * doubleUp(n / 10) + doubleUp(n % 10);
    }
}
```

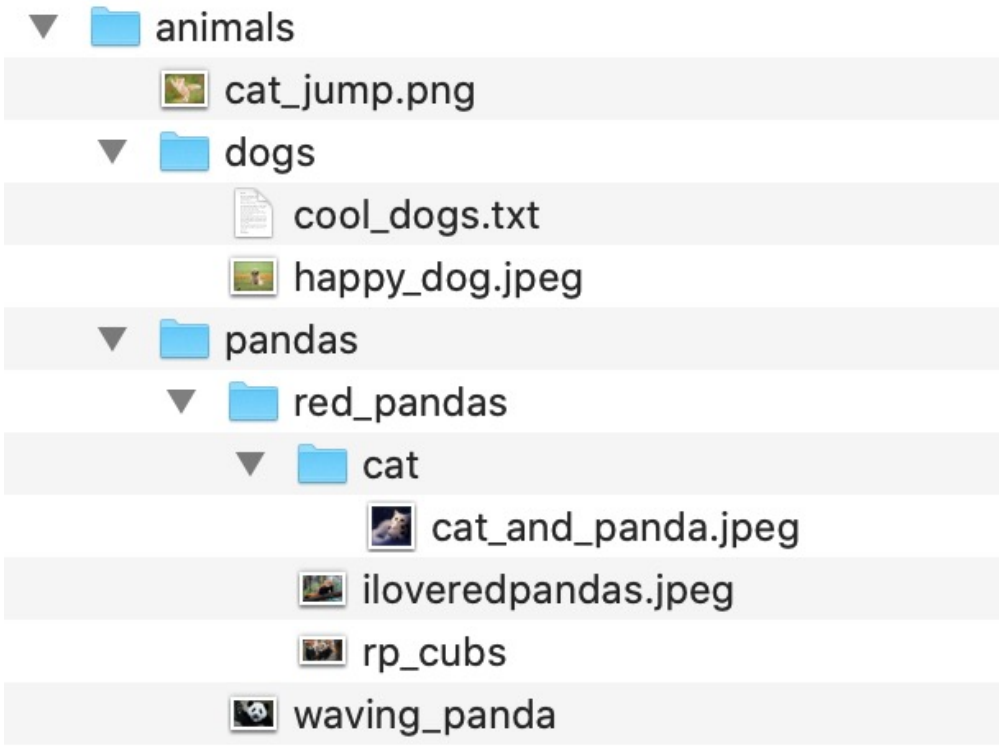
```
Below is a trace of the call doubleUp(-348):
        doubleUp(-348)
            is < 0, so execute first branch
            compute doubleUp(-n), which is doubleUp(348)
            |   not < 0, not < 10, so execute third branch
            |   compute doubleUp(34)
            |   |   not < 0, not < 10, so execute third branch
            |   |   compute doubleUp(3)
            |   |   |   not < 0, but is < 10, so execute second branch
            |   |   |   return n * 11 (33)
            |   |   compute doubleUp(4)
            |   |   |   not < 0, but is < 10, so execute second branch
            |   |   |   return n * 11 (44)
            |   |   return first * 100 + second (33 * 100 + 44 = 3344)
            |   compute doubleUp(8)
            |   |   not < 0, but is < 10, so execute second branch
            |   |   return n * 11 (88)
            |   return first * 100 + second (3344 * 100 + 88 = 334488)
            return the negation of that result (-334488)
```

```
// post: returns a string where every character of str
// is replaced by two of that character
// Example: doubleUp("cat") returns "ccaatt"
// Example: doubleUp("") returns ""
public static String doubleUp(String str) {
    if (str.length() <= 1) {
        return str + str;
    } else {
        char c = str.charAt(0);
        return "" + c + c + doubleUp(str.substring(1));
    }
}
```

Recursive Data - File

- A file is one of:
  - A simple file (image, text file, etc.)
  - A directory containing files

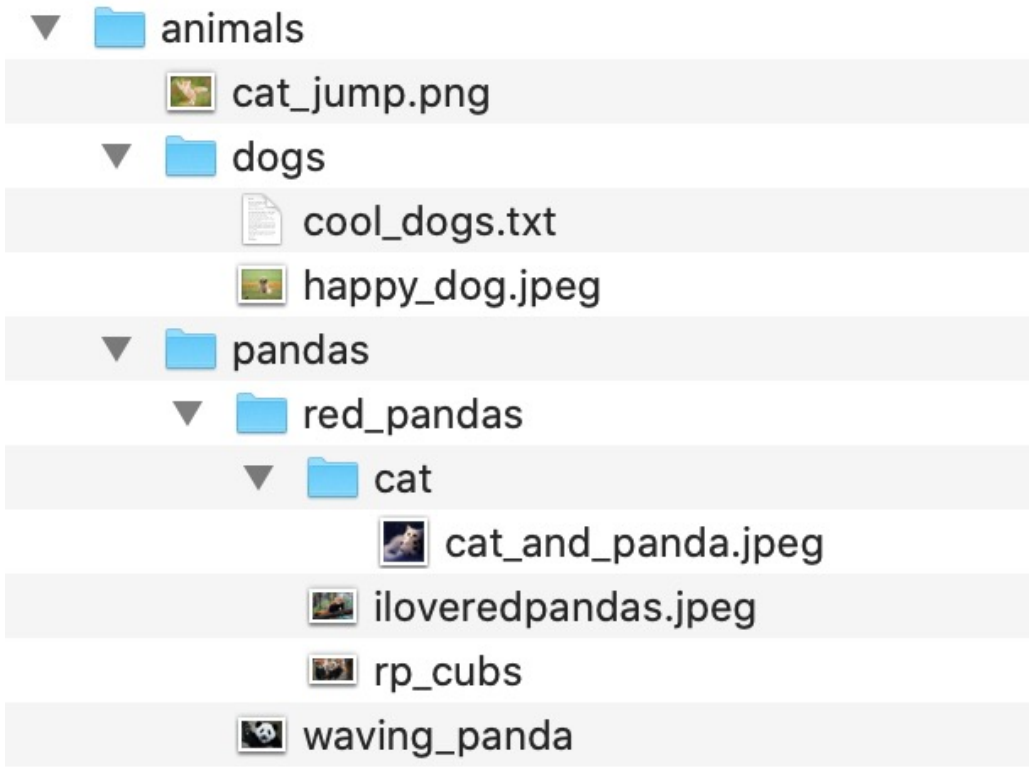
- Directories can be nested to an arbitrary depth



`print` method

- Write a method `print` accepts a `File` parameter and prints information about that file.
  - If the `File` object represents a normal file, just print its name.
  - If the `File` object represents a directory, print its name and information about every file/directory inside it, indented.

```
animals
    cat_jump.png
    dogs
        cool_dogs.txt
        happy_dog.jpeg
    pandas
        red_pandas
            cat
                cat_and_panda.jpeg
            iloveredpandas.jpeg
            rp_cubs.png
        waving_panda.png
```



`File` objects

- A `File` object (from the `java.io` package) represents a file or directory on the disk.

Constructor/method	Description
`File(`**String**`)`	creates `File` object representing file with given name
`canRead()`	returns whether file is able to be read
`delete()`	removes file from disk
`exists()`	whether this file exists on disk
`getName()`	returns file's name
`isDirectory()`	returns whether this object represents a directory
`length()`	returns number of bytes in file
`listFiles()`	returns a `File[]` representing files in this directory
`renameTo(`**File**`)`	changes name of file