Instructions

- For maximum credit you must write your name on *all pages* of the exam. (You get *5 free points* for doing this.)
- You have the full class period to complete the exam. Extra time will only be given for students with learning disablilities officially recognized by the University.
- Laptops, netbooks, smartphones, video game consoles, etc. may not be used during the exam. Turn them off/put them to sleep and keep them out of view. Simple calculators are allowed, but should mostly be unecessary. Whether or not a device qualifies as a simple calculator is entirely up to the instructor.
- No communicating with any other student or looking at any other student's test while taking the exam.
- You are free to leave once you turn in your exam.

Туре

Use the following piece of code to answer questions $1\ {\rm thru}\ 5$ (2 points each.)

```
def f():
    n = 0
    s = 'argag'
    x = ''
while n < 10:
    x = s * n
    print x
    n += 1
```

- 1. What is the type of n?
- 2. What is the type of x?
- 3. What is the type of n < 10?

4. What is the type of f?

5. What is the type of f()?

Runtime

State the runtime of the functions in $\mathbf{6}$ thru $\mathbf{8}$ (5 points each.)

N.B. I don't expect you to remember the exact runtimes of any algorithms for this upcoming final, but knowing them may help you answer some questions.

6. insertion sort

7. norm of a list

8. binary search

Code Tracing

Use the following piece of code for question $\boldsymbol{9}$

```
def log2(n):
    if n == 1:
-->        return 0
    else:
        return 1 + log2(n/2)
```

9. Show the stack diagram for the call log2(32) the first time the line with the arrow is encountered. (10 points)

```
Use the following piece of code for questions 10 and 11 (5 points each.)
```

```
def mystery_function(input_string):
    state = 'q0'
    idx = 0
    while idx < len(input_string):</pre>
        if state == 'q0':
            if input_string[idx] == 'a':
                state = 'q1'
            elif input_string[idx] == 'b':
                state = 'q0'
            else:
                raise RuntimeError, 'Invalid symbol at index %d' % idx
        elif state == 'q1':
            if input_string[idx] == 'a':
                state = 'q1'
            elif input_string[idx] == 'b':
                state = 'q2'
            else:
                raise RuntimeError, 'Invalid symbol at index %d' % idx
        elif state == 'q2':
            if input_string[idx] == 'a':
                state = 'q3'
            elif input_string[idx] == 'b':
                state = 'q0'
            else:
                raise RuntimeError, 'Invalid symbol at index %d' % idx
        elif state == 'q3':
            if input_string[idx] == 'a':
                state = 'q1'
            elif input_string[idx] == 'b':
                state = 'q2'
            else:
                raise RuntimeError, 'Invalid symbol at index %d' % idx
        else:
            raise RuntimeError, 'Invalid state'
        idx += 1
    return state == 'q3'
```

10. What is the value of <code>mystery_function('aabbabbababa')</code>

11. What is the value of mystery_function('bababbbabbba')

Use the following piece of code for questions 12 **thru** 14 **N.B.** See your midterm 2 for the answers to this one.

```
trolliac = {
    'Terezi' : 'Libra',
    'Kanaya' : 'Virgo',
    'Gamzee' : 'Capricorn',
    'Karkat' : 'Cancer',
    'Aradia' : 'Aries',
    'Sollux' : 'Gemini',
}
```

12. What is the value of the list after executing trolliac['Feferi'] = 'Pisces' (3 points.)

13. What is the result of print trolliac['Equius'] (3 points.)

14. What is printed to the screen when the following loop is executed (4 points):

for troll in trolliac:
 print troll

Code Writing

15. Translate the following Python code into MATLAB (10 points):

```
def factorial_difference(n):
    difference = factorial(n)
    for i in range(1, n):
        difference -= factorial(i)
    return difference

def factorial(n):
    product = 1
    for i in range(1, n+1):
        product *= i
    return product
```

16. Write a function string_to_int which takes a string representing some integer and returns the actual integer value of the string (*e.g.* the string '342' would return the number 342.) N.B. You *are not* allowed to use the built in int() function. If you simply return the value of calling that, you will get no points. (13 points.)

N.B. The function ord takes a character and returns it's numeric representation (it's Unicode codepoint, in fact.) You can use this to convert a character into a digit (just subtract the codepoint of 0 from any digit and you'll get that digit.)

17. Write a function mean which takes a list and returns the *mean* (in the mathematical sense - don't overthink this) of that list. (13 points.)

18. Write a function nth_index_of which takes a list stuff, a value elt and a number n and returns the index of the *nth* occurence of *elt* in *stuff*. If there are less than n copies of *elt* in *stuff*, then the function should return -1. (14 points.)