

## CS 101 Proficiency Exam Fall 2016

- Be sure to enter your NetID and the code below on your Scantron.
- Do not turn this page until instructed to.
- There are a total of 200 possible points on this exam.
- There are 30 multiple choice questions worth 5 points each.
- There are 2 coding questions worth 25 points each.
- Each question has only **one** correct answer.
- You must not communicate with other students during this test.
- No books, notes, or electronic devices allowed.
- This is a 120-minute exam.
- There are several different versions of this exam.

### 1. Fill in your information:

Full Name: \_\_\_\_\_

UIN (Student Number): \_\_\_\_\_

NetID: \_\_\_\_\_

### 2. Fill in the following answers on the Scantron form:

95. D

96. C

The following 20 questions are about Python.

1. (5 points) Consider the following simulation program.

```
v=500000
x=0.0
t=0.0
dt=.001
while x<1000:
    t+=dt
    x+=v*dt
```

The program simulates a celestial object moving at constant velocity. Which of the following is a **state variable** in this simulation?

- (A) `v`
- (B) `x`
- (C) `dt`

2. (5 points) Consider the following Python program.

```
x="1 2 3".split()
x=', '.join(x)
try:
    print(x.append(4))
except:
    print(type(x))
```

After it is run, what is printed by this program?

- (A) list
- (B) str
- (C) TypeError
- (D) [1,2,3,4]

3. (5 points) Consider the following Python program.

```
import numpy as np
x=np.array( [2,3,4] ) * 3 - 1
```

After it is run, what is the final **value** of x?

- (A) [ 5 8 11 ]
- (B) None of the other answers are correct

(C) 
$$\begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ 1 & 2 & 3 \end{bmatrix}$$

(D) [ 1 2 3 1 2 3 1 2 3 ]

(E) 
$$\begin{bmatrix} 5 \\ 8 \\ 11 \end{bmatrix}$$

4. (5 points) Consider the following incomplete program.

```
sum=0
for i in range(0,100):
    ???
```

The program is intended to sum all of the integers between 1 and 100 (inclusive). What should replace the three question marks to complete the program?

- (A) `sum+1=sum`
- (B) `sum=sum+i`
- (C) `sum=sum+1`
- (D) `sum=sum+i+1`

5. (5 points) Consider the following incomplete function.

```
def sum_pairs(A):  
    total=0  
    ???  
    return total
```

The function takes a single parameter A, which contains a list of floats. The function is intended to return the sum of all pairs of values in the list (with no repeats.) For example, given the list `[1,2,3]`, the function should return 12, because  $(1+2) + (1+3) + (2+3) = 12$ . What should replace the three question marks to complete the function?

- (A)     for i in range(len(A)):  
            for j in range(i+1,len(A)):  
                total+=A[i]+A[j]
- (B)     for i,j in enumerate(A):  
            total+=A[i]+A[j]
- (C)     for i in range(len(A)):  
            for j in range(len(A)):  
                total+=A[i]+A[j]
- (D)     for i in itertools.permutations(A):  
            total+=i[0]+i[1]

6. (5 points) Consider the following program.

```
import numpy as np
x=np.arange(1,4)
np.random.shuffle(x)
print(x)
```

Which of the following is *not* a possible output for this program?

- (A) [2,3,1]
- (B) [3,2,1]
- (C) All of the other answers are possible outputs.
- (D) [1,2,3]
- (E) [3,1,2]

7. (5 points) Consider the following Python program.

```
e=[1,1,2,2,3,3,4,4,5,5,6,6]
d={0:0,1:0,2:0}
for a,b in enumerate(e):
    d[a%3]+=b
x=d[1]
```

After it is run, what is the final **value** of x?

- (A) 12
- (B) 3
- (C) 22
- (D) 8
- (E) 14

8. (5 points) Consider the following incomplete Python program.

```
s="".join(["2","2","0","1","2"])
x=0
for i in range(len(s)-1):
    x+=int(???)
```

What should replace the three question marks so the resulting value of x is 55?

- (A) `s[i:i+2]`
- (B) `s[i:i-1]`
- (C) `s[i+1:i+2]`
- (D) `s[i:i+1]`

9. (5 points) Consider the following incomplete Python function.

```
def total_sales(sales_file):
    d={}
    for line in open(sales_file):
        ???
    return d
```

The function is intended to compute the total sales of each employee working for a company by reading a comma separated (csv) input file of employee sale data. The result should be stored in a dictionary. The first column of each line in the input file is expected to contain the employee's name represented as a string. The second column is expected to contain a floating point number representing the total for that sale. Here is an example input file:

```
Bob,10.0
Jill,10.55
Jill,115.50
Your program should ignore this line
Bob,30.25
```

The resulting return value for this file should be the following dictionary:

```
{'Bob': 40.25, 'Jill': 126.05}
```

What should replace the three question marks to complete the function?

(A) try:  
    s,f=line.split(",")  
except:  
    continue  
if f not in d:  
    d[f]=0.0  
d[f]+=float(s)

(B) if line not in d:  
    d[line]=0.0  
try:  
    s,f=line.split(",")  
except:  
    d[s]+=float(f)  
    continue

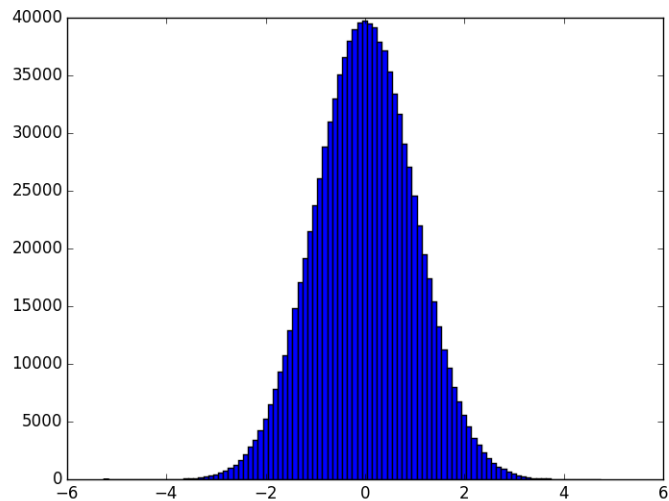
(C) try:  
    s,f=line.split(",")  
    if s not in d:  
        d[s]=0.0  
    d[s]+=float(f)  
except:  
    continue



10. (5 points) Consider the following incomplete program.

```
import matplotlib.pyplot as plt
import numpy as np
???\nplt.hist(x,bins=100)\nplt.show()
```

Which line should replace the three question marks to produce the following plot?



- (A) `x=np.random.shuffle(np.arange(1000000))`
- (B) `x=np.random.choice(np.arange(1000000))`
- (C) `x=np.random.rand(1000000)`
- (D) `x=np.random.randn(1000000)`

11. (5 points) What do we call the optimization heuristic that involves choosing the best from a stochastically sampled subset of the domain?

- (A) Brute-force search
- (B) Gradient descent
- (C) Random search
- (D) Local optimum

12. (5 points) Consider the following program:

```
a=["B","I","L","G","E"]
a.sort()
a[0]=a[-1]
x=""
for e in a:
    x=x+e
```

What is the **value** of x after this program is executed?

- (A) None of the other answers are correct.
- (B) "LEGIL"
- (C) "BILEB"
- (D) "GILEG"
- (E) "BILGB"

13. (5 points) Consider the following incomplete Python program.

```
a="HAMBUG"
b="BUSHWA"
d={}
for x,y in zip(a,b):
    ???
s=""
for c in b:
    s+=d[c]
print(s)
```

Which of the following could replace the three question marks to cause this program to print out

HAMBUG

?

(A) `d[a]=x`

(B) `d[a]=b`

(C) `d[x]=y`

(D) `d[y]=x`

(E) `d[b]=a`

14. (5 points) Consider the following incomplete program.

```
v=0.0
y=1.0
g=-9.8
t=0.0
dt=???
while y>0.0:
    t+=dt
    v+=g*dt
    y+=v*dt
```

The program is intended to simulate an object falling from a height of 1 meter. If we replace the question marks with one of the following values, which choice would produce the most *accurate* simulation?

- (A) 0.0001
- (B) 0.1
- (C) 0.01
- (D) 0.001

15. (5 points) Consider the following program:

```
x=["snip","snap"]
x[0]=len(x[1])
if x[0]<4:
    x="A"
```

What is the **type** of x after the program is run?

- (A) List
- (B) None
- (C) String
- (D) Integer
- (E) None of the other answers are correct.

16. (5 points) Consider the following incomplete program:

```
import itertools
x="HAVER"
???:
    print(x)
```

Replacing the three question marks with which of the following will result in

'HAVER'

being printed exactly five times?

- (A) for a in itertools.combinations(x,2)
- (B) for a in itertools.combinations(x,4)
- (C) for a in itertools.combinations(x,5)
- (D) for a in itertools.combinations(x,3)

17. (5 points) Consider the following program.

```
y=1
for i in range(0,3):
    y=y+(2*y)
x=y>10
```

After it is run, what is the final **value** of x?

(A) False

(B) True

18. (5 points) Consider the following program:

```
a=1
def fun(a):
    a=2
    return a+1
    a=4
fun(a)
print(a)
```

What is printed out by this program?

(A) 2

(B) None of the other answers. This code is not valid.

(C) 1

(D) 3

(E) 4

19. (5 points) Consider the following incomplete Python program:

```
x=[ ]
for i in range(1,101):
    for j in range(i+1,101):
        t=i,j
        x.append(t)
```

After the program runs, which of the following is an element of x?

- (A) (78,78)
- (B) (0,33)
- (C) (10,52)
- (D) (42,15)
- (E) (11,4)

20. (5 points) Consider the following program:

```
s="BABOONERY"
x=""
for i in range(0,len(s)):
    if (i>3) and (i<6):
        x+=s[i:i+2]
```

What is the **value** of x after this program is executed?

- (A) "NE"
- (B) "ONNE"
- (C) "OO"
- (D) None of the other answers are correct.
- (E) "OOON"

The following 10 questions are about MATLAB.

21. (5 points) Consider the following MATLAB program.

```
A=eye(3,3);  
for x=2:1:3  
    A(x,x)=0;  
end
```

After it is run, what is the final **value** of A?

(A)  $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

(B)  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(C)  $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

(D)  $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$

(E)  $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$



22. (5 points) Consider the following MATLAB program.

```
A=[3,2,1;0,2,1;0,0,1];  
B=(2*eye(3,3)*A)-A;  
x=B(1,1)+B(2,2)+B(3,3);
```

After it is run, what is the final **value** of x?

- (A) 2
- (B) 5
- (C) 6
- (D) 3
- (E) 1

23. (5 points) Consider the following MATLAB program.

```
x=3:2:7;  
y=4:2:8;  
z=x+y;
```

After it is run, what is the final **value** of z?

- (A)  $\begin{bmatrix} 3 & 5 & 7 \\ 4 & 6 & 8 \end{bmatrix}$
- (B)  $\begin{bmatrix} 7 & 11 \end{bmatrix}$
- (C)  $\begin{bmatrix} 7 & 11 & 15 \end{bmatrix}$
- (D)  $\begin{bmatrix} 3 & 2 & 7 \\ 4 & 2 & 8 \end{bmatrix}$
- (E)  $\begin{bmatrix} 3 & 7 \\ 4 & 8 \end{bmatrix}$

24. (5 points) Consider the following MATLAB program.

```
A=[1,1,1;0,1,1;0,0,1];  
B=A';  
x=B(1,1)+B(2,2)+B(3,3);
```

After it is run, what is the final **value** of x?

- (A) 2
- (B) 1
- (C) None of the other answers are correct.
- (D) 0
- (E) 3

25. (5 points) Consider the following MATLAB program.

```
A=eye(3,3)+ones(3,3);  
for x=1:3  
    for y=1:3  
        if x>y  
            A(x,y)=x+y;  
        end  
    end  
end
```

After it is run, what is the final **value** of A?

(A)  $\begin{bmatrix} 2 & 3 & 4 \\ 1 & 2 & 5 \\ 1 & 1 & 2 \end{bmatrix}$

(B)  $\begin{bmatrix} 2 & 1 & 1 \\ 3 & 4 & 1 \\ 4 & 4 & 6 \end{bmatrix}$

(C)  $\begin{bmatrix} 2 & 3 & 4 \\ 1 & 4 & 5 \\ 1 & 1 & 6 \end{bmatrix}$

(D)  $\begin{bmatrix} 2 & 1 & 1 \\ 3 & 2 & 1 \\ 4 & 5 & 2 \end{bmatrix}$

26. (5 points) Consider the following MATLAB program.

```
A=[ones(2,2),[2;2]];3,3,3];  
x=A(2,3);
```

After it is run, what is the final **value** of x?

(A) 2

(B) 3

(C) 0

(D) 1

27. (5 points) Consider the following MATLAB program.

```
x=[1,2];  
y=[3,4];  
z=[y,x;x,y]';
```

After it is run, what is the final **value** of z?

(A)  $\begin{bmatrix} 3 & 4 & 1 & 2 \\ 1 & 2 & 3 & 4 \end{bmatrix}$

(B) None of the other answers are correct

(C)  $\begin{bmatrix} 3 & 1 \\ 4 & 2 \\ 1 & 3 \\ 2 & 4 \end{bmatrix}$

(D)  $\begin{bmatrix} 1 & 3 \\ 2 & 4 \\ 3 & 1 \\ 4 & 2 \end{bmatrix}$

(E)  $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 3 & 4 & 1 & 2 \end{bmatrix}$

28. (5 points) Consider the following MATLAB program.

```
x=(3<5) && (2>3)
```

After it is run, what is the final **value** of x?

- (A) True
- (B) 0
- (C) 1
- (D) False

29. (5 points) Consider the following 2-dimensional MATLAB array:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \\ 10 & 11 & 12 \end{bmatrix}$$

Assuming it is stored in a variable named A, how can we index and retrieve the value 8?

- (A) A(2,3)
- (B) A(3,2)
- (C) A(1,2)
- (D) A(2,1)

30. (5 points) Consider the following MATLAB program.

```
x=[2;3;4];  
x=3*eye(3,3)*x;  
x=x(1)+x(2)+x(3)
```

After it is run, what is the final **value** of x?

- (A) 27
- (B) The program contains a syntax error and will not run.
- (C) 12
- (D) 9
- (E) 6

The following 2 coding questions are about Python.

Be sure to write clearly and comment your code, so we can understand your answer.

31. (25 points) Your friend Vanessa can't remember her Facebook password and wants your help figuring it out. She remembers the password is exactly 9 characters long. She also remembers that her username is either "vanessa" or "VanessaC" or "Vanessa95". Assume someone else has already written a function `login` that takes a two string arguments representing a username and password combination. `login` returns `True` if the input username and password are valid credentials for Facebook and `False` otherwise. Your function `guess_password` should perform a brute force search and return the correct username and password for Vanessa's account as a tuple of two strings.

We set up the alphabet string for you. Assume all of the possible password characters are contained in this string. You may import `itertools` in your solution if you prefer, but no other libraries are allowed.

```
def guess_password():
    alphabet="ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz"
    alphabet+="0123456789!@#%&*()-_+=,<.>/?~`"
```

32. (25 points) Write a Python program to simulate a population of rabbits for 50 years. Your simulation should update annually (i.e.  $\Delta t = 1$  year). The initial population of rabbits is 15. Each year, 5% of the population of the previous year dies off, and each year exactly 5 new rabbits are born. In your simulation, it should be impossible for “partial rabbits” to exist. For example, the population should never be 13.7. 70% of a rabbit is a grisly idea, and it’s probably best that we don’t spend any more time thinking about it. You should always round the population *down* to a whole number.

You may import NumPy in your solution if you prefer, but no other libraries are allowed.