

Math 300 Test 2

Name: _____

You have two hours. All paper notes are permitted, but no electronic devices may be used. Note that problems 1 and 2 both use display math.

1. (10 pts) Write L^AT_EX commands to typeset $S_N^k = \left\{ \frac{n}{2^k} \right\}_{n=0}^N$, $k = 0, 1, 2, \dots$

`$$S_N^k = \left\{ \frac{n}{2^k} \right\}_{n=0}^N, \quad k=0,1,2,\dots$$`

2. (5 pts) Write MathML commands to typeset S_N^k

```
<math mode='display'>
<msubsup>
<mi>S</mi><mi>N</mi><mi>k</mi>
</msubsup>
```

3. (10 pts) Write Matlab commands to create an array whose first column contains ones, and whose second column contains the even-numbered years from 1492 to 2016.

```
A(:,2)=1492:2:2016;    or    A=ones(263,2);
A(:,1)=1              for i=1:263
                      A(i,2)=1492+(i-1)*2
                      end
```

There are many other ways...

4. (9 pts) Write Python commands to plot $\cos \pi x + \frac{1}{2} \sin 4\pi x$ on the interval $[-2, 2]$. Make sure the curve is smooth, and that the x and y axes are labeled x and $J(x)$, respectively.

```
h=0.01
x=arange(-2,2+h,h)
plot(x,cos(pi*x)+0.5*sin(4.0*pi*x))
xlabel('x')
ylabel('J(x)')
show()
```

5. (6 pts) In hexadecimal, what is $AF+1$? Write the result in both hexadecimal and decimal.

```
AF
+ 1    Don't forget to carry the one...
---
B0    Now, B0 in hex is 11x16+0x1 = 176 in decimal.
```

6. (10 pts) Write a Python function called `shrink` that takes a single vector $x = (x_0, x_1, \dots, x_n)$ as its only argument, and returns a vector $y = (x_0, x_1/2, x_2/4, \dots, x_n/2^n)$.

```
def shrink(x):
    p = 2.0**(-arange(len(x)))
    return x*p
```

Of course, there are many other ways.

7. (10 pts) Given that we imported Sympy as `sp`, what Python command(s) would you use to evaluate $\int_0^\pi (\sin^3 x + \sin 2x) dx$ to 47 digits of accuracy?

```
sp.integrate(sp.sin(x)**3+sp.sin(2*x),(x,0,sp.pi)).evalf(47)
```

8. (5 pts) Write CSS to make all text in a division with id `serious` appear in a Comic Sans font on those machines that have such, and as any other sans-serif on those machines that don't.

```
#serious{font-family: Comic Sans, sans-serif}
```

9. (10 pts) Write L^AT_EX to make the table at right.

Naughty	92%
Nice	8%

```
\begin{tabular}{|l|l|}
\hline
Naughty & 92%\
Nice & 8%\
\hline
\end{tabular}
```

10. (4 pts) In Matlab, we could approximate the derivative of $f(x) = x^2$ at 1 using the difference quotient $(f(1+1e-17)-f(1))/1e-17$. What is the value of that difference quotient?

Matlab uses 64-bit floating point arithmetic, which means that it can use about 16 digits for decimal representations. $1+1e-17$ requires 18 digits to represent, so it gets truncated to... 1. Thus, in floating point arithmetic: $(f(1+1e-17)-f(1))/1e-17 = (f(1)-f(1))/1e-17 = 0/1e-17 = 0$.

11. (5 pts) Make an HTML description list to duplicate this one:

Trivium:

American

Novembre:

Italian – *Now defunct*

```
<dl><dt><b>Trivium:</b></dt>
<dd>American</dd>
<dt><b>Novembre:</b></dt>
<dd>Italian - <i>Now defunct</i></dd>
</dl>
```

12. (16 pts) Write a Python function that can be called as `uh_oh(n)`, that takes a single integer argument n , and returns $\sum_{k=0}^n k!$. Hint: you do not know how to call a `factorial()` method from Pylab or its components.

```
def uh_oh(n):
    if n==0:
        return 1
    fac = 1
    tot = 1
    for k in arange(n):
        fac *= (k+1)
        tot += fac
    return tot          # Of course, there are other ways...
```