

PRACTICAL 1

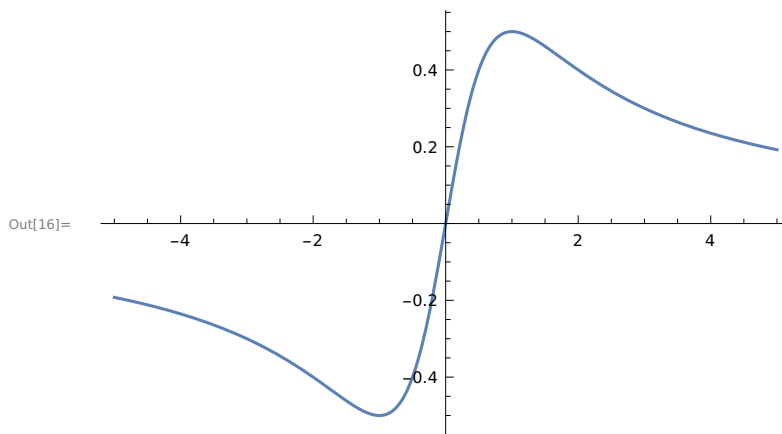
Bhakti Sharma MAT/19/92

Q1. Graph each of the following functions.

a) $f(x)=x/(1+x^2)$

In[15]:= $f[x_] := \frac{x}{1 + x^2};$

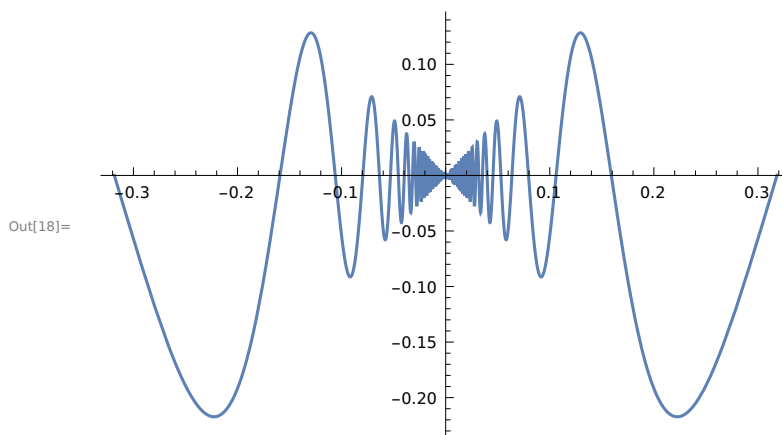
In[16]:= $\text{Plot}[f[x], \{x, 5, -5\}]$



b) $y=x \sin(1/x)$

In[17]:= $y[x_] := x \sin(1/x);$

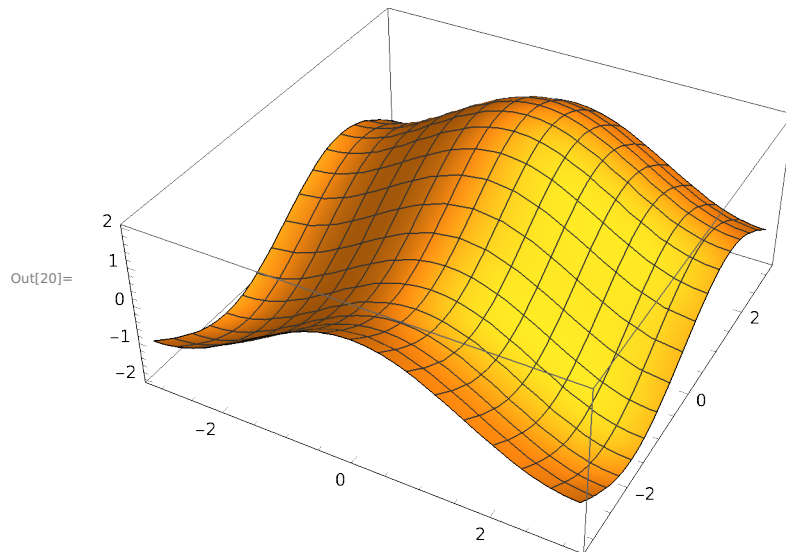
$\text{Plot}[x \sin[1/x], \{x, 1/\pi, -1/\pi\}]$



In[19]:=

c) $g(x,y)=\cos(x)+\sin(y)$

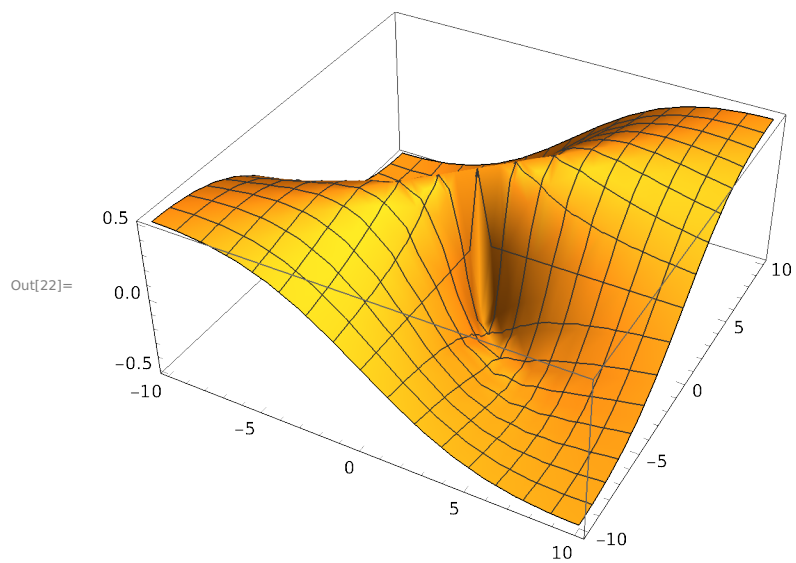
In[20]:= `Plot3D[Cos[x] + Sin[y], {x,  $\pi$ ,  $-\pi$ }, {y,  $\pi$ ,  $-\pi$ }]`



In[21]:= **(d)** $z = \frac{xy}{x^2 + y^2}$

Out[21]= $\frac{xy}{x^2 + y^2}$

In[22]:= `Plot3D[ $\frac{xy}{x^2 + y^2}$ , {x, 10, -10}, {y, 10, -10}]`



Q2. Let $f[x_] := x / (1 + x^2)$

(a) $f'[x]$

$$\text{Out[24]} = -\frac{2x^2}{(1+x^2)^2} + \frac{1}{1+x^2}$$

In[25]:= $f''[x]$

$$\text{Out[25]} = \frac{8x^3}{(1+x^2)^3} - \frac{6x}{(1+x^2)^2}$$

b) Find $f'(-1)$ and $f'(0)$

In[26]:= $f'[-1]$

Out[26]= 0

In[27]:= $f'[0]$

Out[27]= 1

c) Find $f''(0)$ and $f''(1)$

In[28]:= $f''[0]$

Out[28]= 0

In[29]:= $f''[1]$

$$\text{Out[29]} = -\frac{1}{2}$$

Q3). Find the prime factorization of each integer.

a) 3527218133309949276293

In[30]:= FactorInteger [3 527 218 133 309 949 276 293]

Out[30]= {{15 013 , 2}, {25 013 , 3}}

(b) 471945325930166269

In[31]:= FactorInteger [471 945 325 930 166 269]

Out[31]= {{4211 , 1}, {34 589 , 1}, {46 747 , 1}, {69 313 , 1}}

(c) 471945325930166281

In[32]:= FactorInteger [471 945 325 930 166 281]

Out[32]= {{471 945 325 930 166 281 , 1}}

Q4. Compute each expression. Do you notice a pattern?

(a) $3^6 \bmod 7$

In[33]:= PowerMod [3 , 6 , 7]

Out[33]= 1

(b) $6^{10} \bmod 11$

In[34]:= **PowerMod[6, 10, 11]**

Out[34]= 1

(c) $7^{20} \bmod 21$

In[35]:= **PowerMod[7, 20, 21]**

Out[35]= 7

(d) $7^{22} \bmod 23$

In[36]:= **PowerMod[7, 22, 23]**

Out[36]= 1

Q8. Let $M = \{\{1, 1\}, \{0, 1\}\}$

(a) Find $M^2, M^3, \dots, M^{10}$.

In[37]:= **M = {{1, 1}, {1, 0}}**

Out[37]= {{1, 1}, {1, 0}}

In[38]:= **Table[MatrixPower[M, n], {n, 2, 10}]**

Out[38]= {{2, 1}, {1, 1}}, {{3, 2}, {2, 1}}, {{5, 3}, {3, 2}}, {{8, 5}, {5, 3}}, {{13, 8}, {8, 5}},
{{21, 13}, {13, 8}}, {{34, 21}, {21, 13}}, {{55, 34}, {34, 21}}, {{89, 55}, {55, 34}}

In[39]:= **Fibonacci[100, M]**

Out[39]= {{354 224 848 179 261 915 075 , 354 224 848 179 261 915 075 }, {354 224 848 179 261 915 075 , 0}}

In[40]:= **Fibonacci[100]**

Out[40]= 354 224 848 179 261 915 075

Q9. Find solutions to the following equations or systems of equations.

(a) Find x , if $x^2 + x = 1$.

In[41]:= **Solve[x^2 + x == 1, x]**

Out[41]= $\left\{ \left\{ x \rightarrow \frac{1}{2}(-1 - \sqrt{5}) \right\}, \left\{ x \rightarrow \frac{1}{2}(-1 + \sqrt{5}) \right\} \right\}$

(b) Find x , if $x^2 + x = -1$

In[42]:= **Solve[x^2 + x == -1, x]**

Out[42]= $\left\{ \left\{ x \rightarrow -(-1)^{1/3} \right\}, \left\{ x \rightarrow (-1)^{2/3} \right\} \right\}$

(c) Find x and y . $4x - 3y = 5$ and $6x + 2y = 14$

In[43]:= **Solve[4 x - 3 y == 5 && 6 x + 2 y == 14, {x, y}]**

Out[43]= {{x → 2, y → 1}}

(d) Find x, y, z and t .

$-2x-2y+3z+t=8$, $-3x+0y-6z+t=-19$, $6x-8y+6z+5t=47$, $x+3y-3z-t=-9$.

```
In[44]:= Solve[-2 x - 2 y + 3 z + t == 8 &&
      -3 x + 0 y - 6 z + t == -19 && 6 x - 8 y + 6 z + 5 t == 47 && x + 3 y - 3 z - t == -9]
```

```
Out[44]= {{t -> 5, x -> 2, y -> 1, z -> 3}}
```

Q10. Solve this equation for r.

```
In[45]:= Solve[{250 e^r + 300 e^0.75 r + 350 e^0.5 r + 400 e^0.25 r == 1365}, r]
```

```
Out[45]= {{r -> 0.541896}}
```

Q11. Write a function called mysqrt that accepts one argument, begins with an initial guess of 1.0, 0 finds 20 new guesses, and returns the answer.

```
In[46]:= mysqrt[n_] := Module[{i = 1, g = 1}, While[i ≤ 20, g =  $\frac{1}{2} \left( g + \frac{n}{g} \right)$ ; i = i + 1]; g]
```

```
In[47]:= N[mysqrt[2], 6]
```

```
Out[47]= 1.41421
```

```
In[48]:= N[Sqrt[2], 6]
```

```
Out[48]= 1.41421
```

```
In[49]:= N[mysqrt[3]]
```

```
Out[49]= 1.73205
```

Q12. (a) Write a function called collatz that accepts a single argument, n, and returns:

- 0 if $n=1$,
- $1+\text{collatz}(n/2)$ if n is even.
- $1+\text{collatz}(3*n+1)$ if n is odd.

```
In[50]:= collatz[n_] := Which[n = 1, collatz[n] = 0, EvenQ[n],
      collatz[n] = 1 + collatz[n/2], OddQ[n], collatz[n] = 1 + collatz[3 * n + 1]];
```

```
In[50]:= collatz[1]
```

```
Out[50]= 0
```

```
In[51]:= collatz[2]
```

```
Out[51]= 1
```

```
In[52]:= collatz[6]
```

```
Out[52]= 8
```

```
In[53]:= collatz[27]
```

```
Out[53]= 111
```

