APP_Exercise_7

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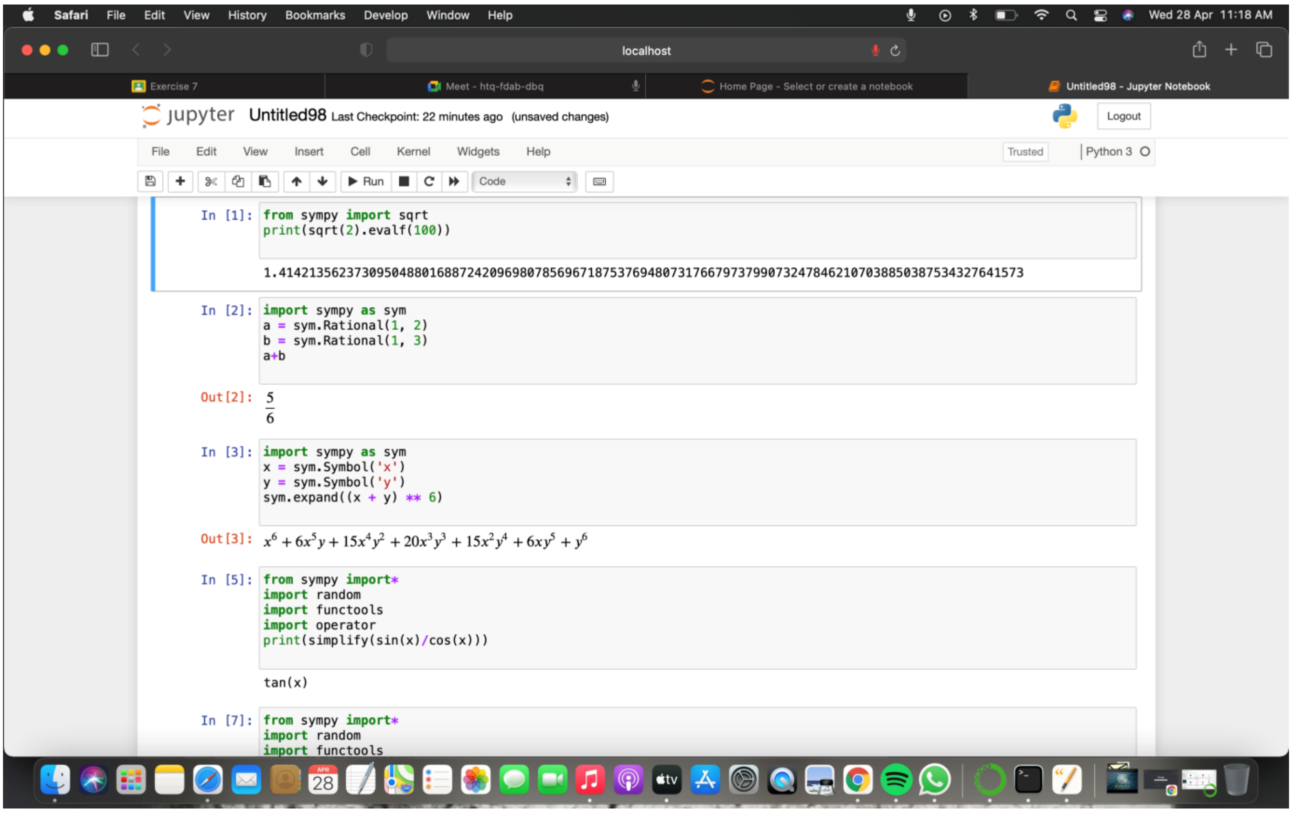
1. Solve the following using symbolic paradigm:

i. Calculate sqrt (2) with 100 decimal
ii. Calculate (1/2+1/3) in rational arithmetic.
iii. Calculate the expanded form of (x+y) ^ 6.
iv. Simplify the trigonometric expression sin (x) / cos (x) v. Calculate sin x -xx^3n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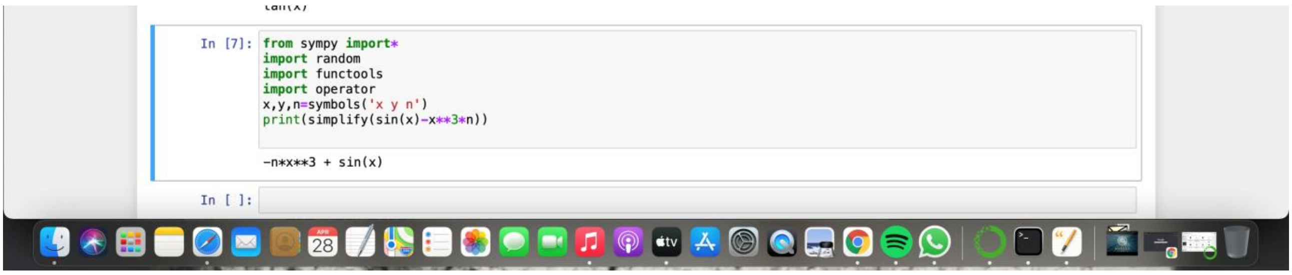
```
In [1]: from sympy import sqrt
        print(sqrt(2).evalf(100))

        1.414213562373095048801688724209698078569671875376948073176679737990732478462107038850387534327641573

In [2]: import sympy as sym
        a = sym.Rational(1, 2)
        b = sym.Rational(1, 3)
        a+b
```

Out[2]: $\frac{5}{6}$

```
In [3]: import sympy as sym
        x = sym.Symbol('x')
        y = sym.Symbol('y')
        sym.expand((x + y) ** 6)
```

Out[3]: $x^6 + 6x^5y + 15x^4y^2 + 20x^3y^3 + 15x^2y^4 + 6xy^5 + y^6$

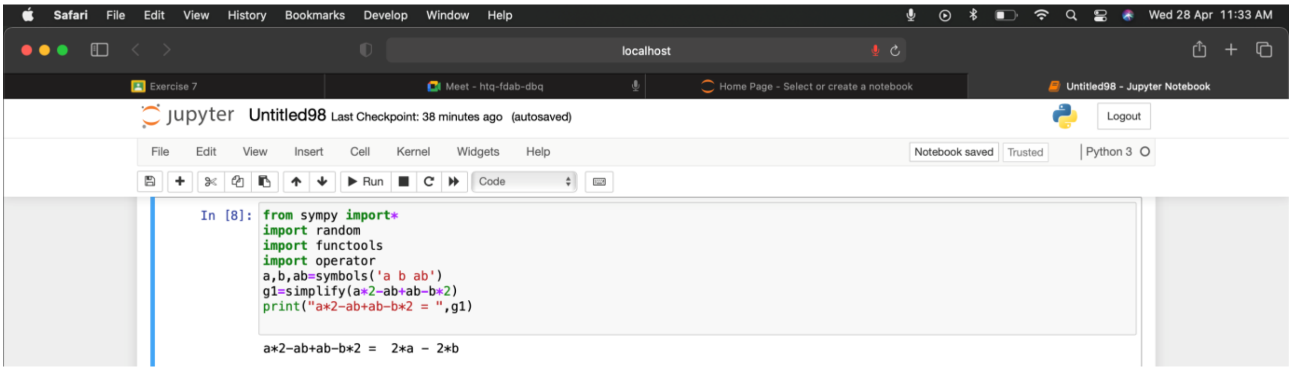
```
In [5]: from sympy import*
        import random
        import functools
        import operator
        print(simplify(sin(x)/cos(x)))

        tan(x)

In [7]: from sympy import*
        import random
        import functools
```



```
        tan(x)

In [7]: from sympy import*
        import random
        import functools
        import operator
        x,y,n=symbols('x y n')
        print(simplify(sin(x)-x**3*n))

        -n*x**3 + sin(x)

In [ ]:
```

2. Develop a python code for to carryout the operations on the given algebraic manipulation for

the given expression a 2 −ab+ab−b 2 =a 2 −b 2 by using the symbolic programming paradigms principles.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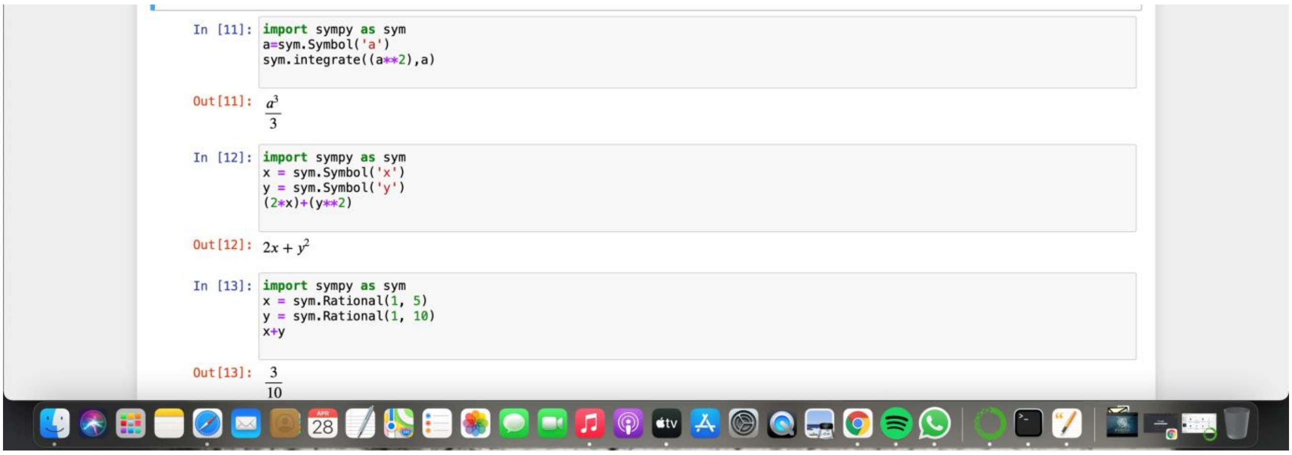
Code

```
In [8]: from sympy import*
        import random
        import functools
        import operator
        a,b,ab=symbols('a b ab')
        g1=simplify(a*2-ab+ab-b*2)
        print("a*2-ab+ab-b*2 = ",g1)

        a*2-ab+ab-b*2 =  2*a - 2*b
```

3. Give the Symbolic program for the expression given below: a. ∫∫a 2 da
b. 2x+y 2
c. 1/10 + 1/5

d. d/dx(sin(x))



```
In [11]: import sympy as sym
         a=sym.Symbol('a')
         sym.integrate((a**2),a)
```

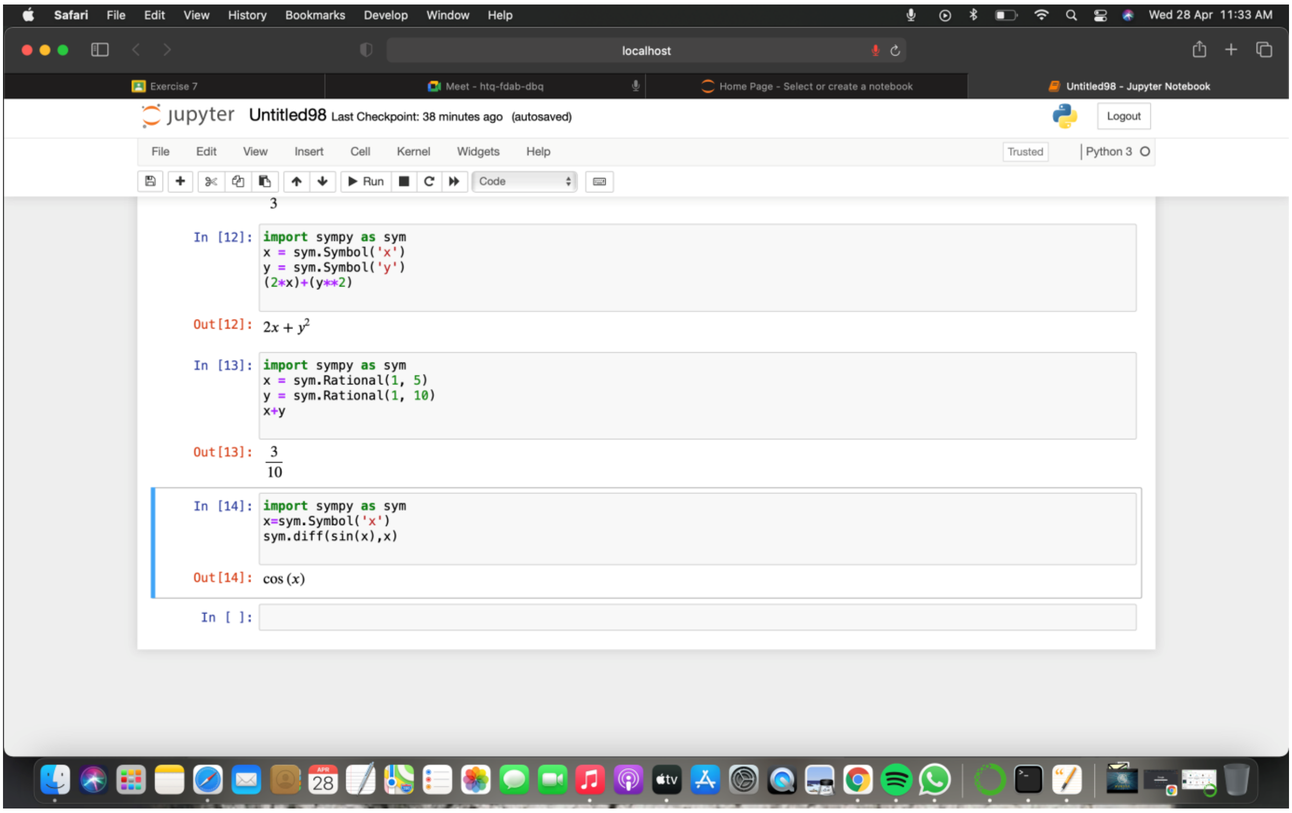
Out[11]: $\frac{a^3}{3}$

```
In [12]: import sympy as sym
         x = sym.Symbol('x')
         y = sym.Symbol('y')
         (2*x)+(y**2)
```

Out[12]: $2x + y^2$

```
In [13]: import sympy as sym
         x = sym.Rational(1, 5)
         y = sym.Rational(1, 10)
         x+y
```

Out[13]: $\frac{3}{10}$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Run
Code

```
    3

In [12]: import sympy as sym
         x = sym.Symbol('x')
         y = sym.Symbol('y')
         (2*x)+(y**2)

Out[12]: 2x + y^2

In [13]: import sympy as sym
         x = sym.Rational(1, 5)
         y = sym.Rational(1, 10)
         x+y

Out[13]: 3/10

In [14]: import sympy as sym
         x=sym.Symbol('x')
         sym.diff(sin(x),x)

Out[14]: cos(x)

In [ ]:
```

Logic Programming:

1. Implement using pyDatalog:

Assume given a set of facts of the form father(name1,name2) (name1 is the father of name2).

a. Define a predicate brother(X,Y) which holds iff X and Y are brothers.

b. Define a predicate cousin(X,Y) which holds iff X and Y are cousins.

c. Define a predicate grandson(X,Y) which holds iff X is a grandson of Y.

d. Define a predicate descendent(X,Y) which holds iff X is a descendent of Y.

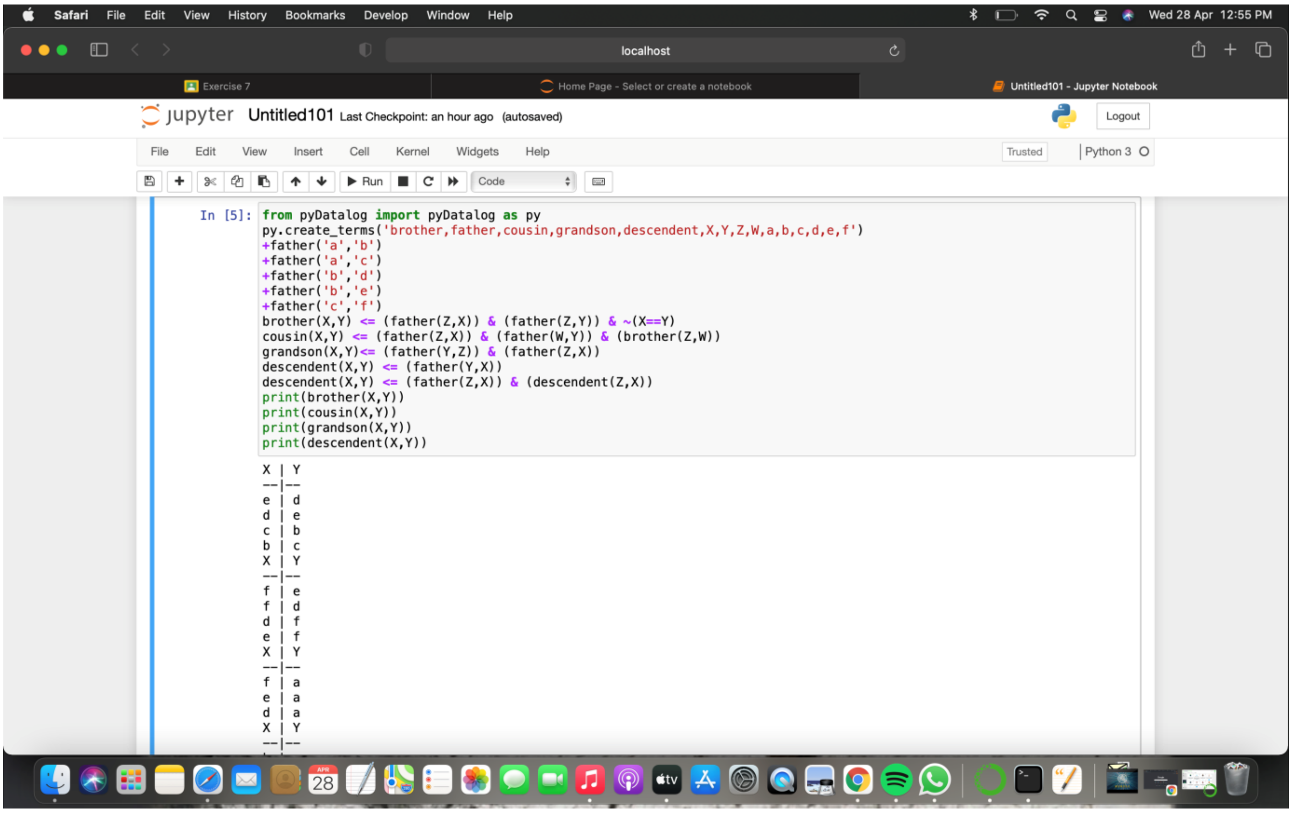
e. Consider the following genealogical tree:

a /\ bc /\| def

What are the answers generated by your definitions for the queries: brother(X,Y)

---

cousin(X,Y) grandson(X,Y) descendent(X,Y)



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Code

```
In [5]: from pyDatalog import pyDatalog as py
        py.create_terms('brother,father,cousin,grandson,descendent,X,Y,Z,W,a,b,c,d,e,f')
        +father('a','b')
        +father('a','c')
        +father('b','d')
        +father('b','e')
        +father('c','f')
        brother(X,Y) <= (father(Z,X)) & (father(Z,Y)) & ~(X==Y)
        cousin(X,Y) <= (father(Z,X)) & (father(W,Y)) & (brother(Z,W))
        grandson(X,Y)<= (father(Y,Z)) & (father(Z,X))
        descendent(X,Y) <= (father(Y,X))
        descendent(X,Y) <= (father(Z,X)) & (descendent(Z,X))
        print(brother(X,Y))
        print(cousin(X,Y))
        print(grandson(X,Y))
        print(descendent(X,Y))
```

```
X | Y
--|--
e | d
d | e
c | b
b | c
X | Y
--|--
f | e
f | d
d | f
e | f
X | Y
--|--
f | a
e | a
d | a
X | Y
--|--
```

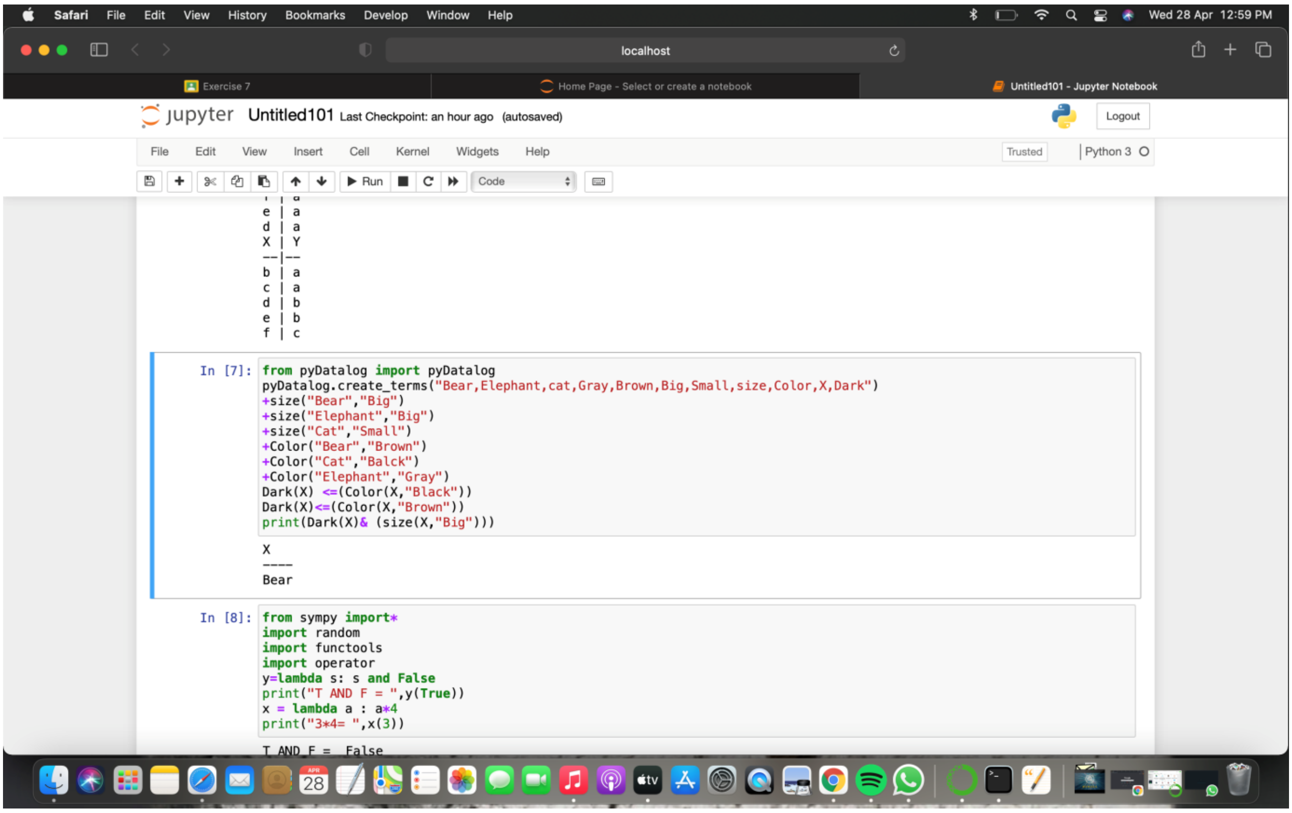
2. Encode the following facts and rules in pyDatalog: • Bear is big
• Elephant is big
• Cat is small

• Bear is brown

• Cat is black
• Elephant is gray

• An animal is dark if it is black • An animal is dark if it is brown

Write a query to find which animal is dark and big



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Code

```
f | a
e | a
d | a
X | Y
--|--
b | a
c | a
d | b
e | b
f | c
```

```
In [7]: from pyDatalog import pyDatalog
        pyDatalog.create_terms("Bear,Elephant,cat,Gray,Brown,Big,Small,size,Color,X,Dark")
        +size("Bear","Big")
        +size("Elephant","Big")
        +size("Cat","Small")
        +Color("Bear","Brown")
        +Color("Cat","Balck")
        +Color("Elephant","Gray")
        Dark(X) <=(Color(X,"Black"))
        Dark(X)<=(Color(X,"Brown"))
        print(Dark(X)& (size(X,"Big")))

        X
        ----
        Bear
```

```
In [8]: from sympy import*
        import random
        import functools
        import operator
        y=lambda s: s and False
        print("T AND F = ",y(True))
        x = lambda a : a*4
        print("3*4= ",x(3))

        T AND F =  False
```

1. The following are the marks scored by 5 students.

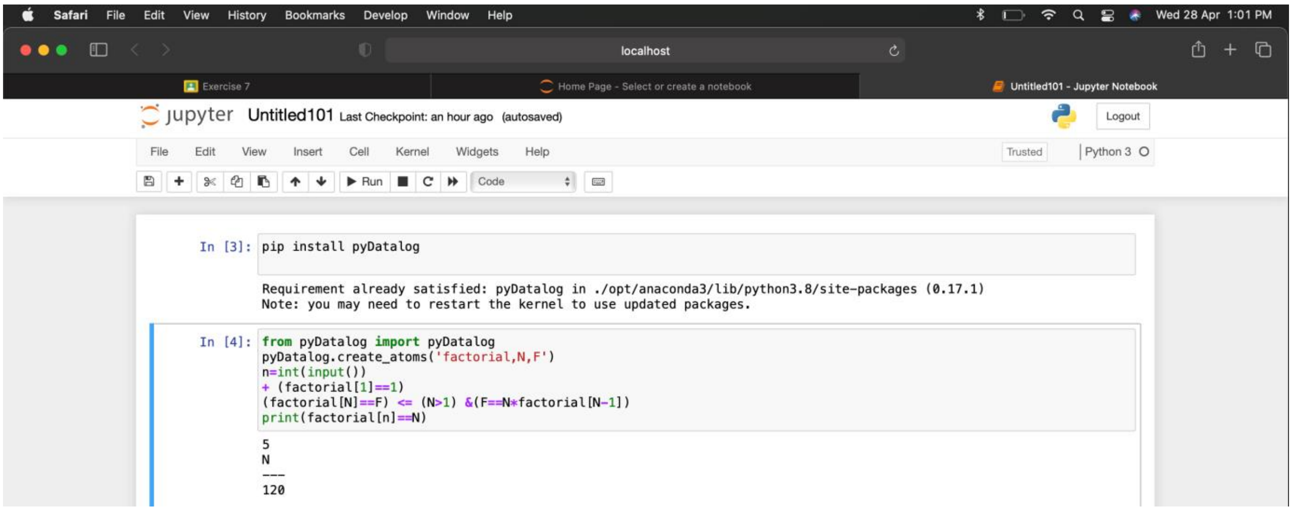
Student Name	Mark
Ram	90
Raju	45
Priya	85
Carol	70
Shyam	80

Enter the above data using pyDatalog.
Write queries for the following:
a. Print Student name and mark of all students.
b. Who has scored 80 marks?
c. What mark has been scored by Priya?
d. Write a rule ‘passm’ denoting that pass mark is greater than 50. Use the rule to print all students who failed.
e. Write rules for finding grade letters for a marks and use the rule to find the grade

letter of a given mark.

1. Solve the set of queries in the previous question using imperative programming paradigm in Python. Store the data in a dictionary.

1. Write a recursive program to find factorial of a number using pyDatalog.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Code

```
In [3]: pip install pyDatalog

        Requirement already satisfied: pyDatalog in ./opt/anaconda3/lib/python3.8/site-packages (0.17.1)
        Note: you may need to restart the kernel to use updated packages.

In [4]: from pyDatalog import pyDatalog
        pyDatalog.create_atoms('factorial,N,F')
        n=int(input())
        + (factorial[1]==1)
        (factorial[N]==F) <= (N>1) &(F==N*factorial[N-1])
        print(factorial[n]==N)

        5
        N
        ---
        120
```

Functional Programming:

1. Calculate the following using Lambda calculus: a. T AND F
b. 3 * 4
2. Lambda functions

a. Write a lambda function to convert measurements from meters to feet.
b. Write a lambda function in Python to implement the following lambda expression:

(. . (+))(. 2)()

Note: You need to write a nested lambda function for implementing f+m where f takes the square function (which takes argument x) passed as a parameter. The above expression calculates a 2 +b.

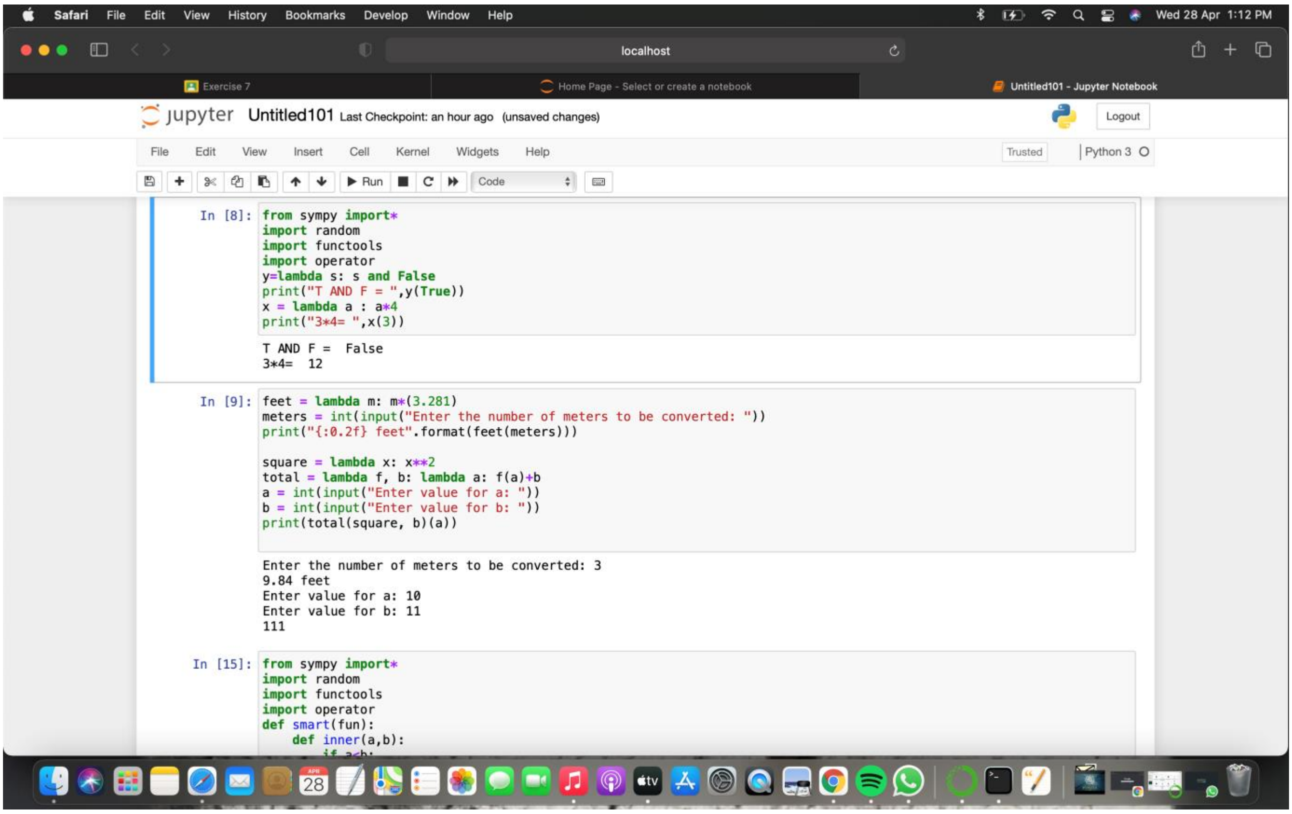
4. Closure
A Closure is a function object that remembers values in enclosing scopes even if they are not present in memory. We have a closure in Python when a nested function references a value in its enclosing scope.
a. Study the following program by executing it:

```
def multiplier_of(n):
def multiplier(number):
return number*n
return multiplier
multiplywith5 = multiplier_of(5) print(multiplywith5(9))
```

b. In a lottery system, random number is chosen by retrieving the number from a random index from a list of random numbers. Write a program to

choose a random number in this way. You must use nested functions – the inner function chooses a number from a random index and the outer function generates a random list of numbers. The outer function takes n as a parameter where is the maximum number that can be put in the random list. (Your code should be similar to the program in 5a)

6. Map
A secret message needs to be sent. Use the map function to encrypt the message using Caesar cipher.
7. Reduce
Given runs scored by 2 players in a series of matches, write a Python program using reduce function to
find who is the better player of the two in terms of maintaining consistency. (You need to find SD).
9. Map+reduce+filter
Given two trending topics and a bunch of tweets, write a Python program to count the number of tweets
that contain each topic. You need to do this by putting together map(), reduce() and filter() functions.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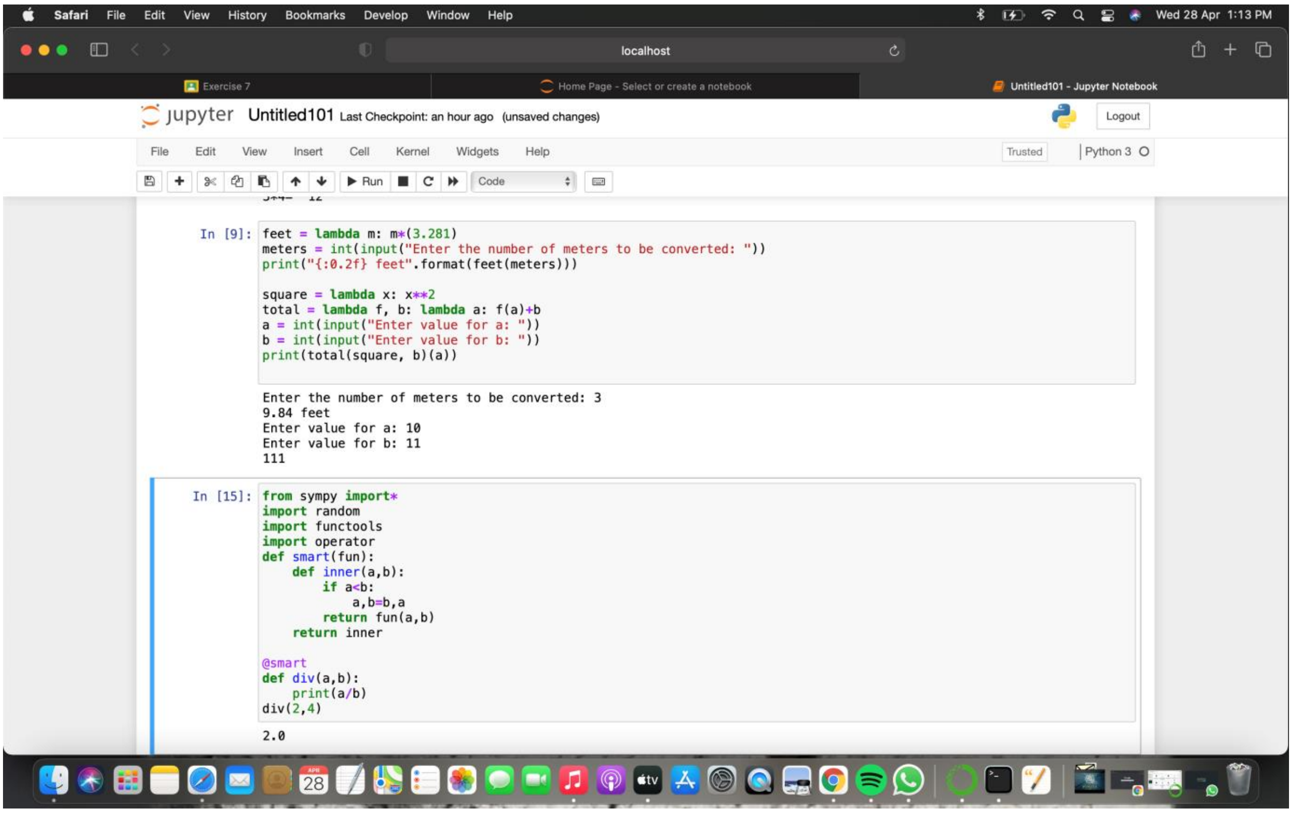
Code

```
In [8]: from sympy import*
        import random
        import functools
        import operator
        y=lambda s: s and False
        print("T AND F = ",y(True))
        x = lambda a : a*4
        print("3*4= ",x(3))

        T AND F =  False
        3*4=  12

In [9]: feet = lambda m: m*(3.281)
        meters = int(input("Enter the number of meters to be converted: "))
        print("{:0.2f} feet".format(feet(meters)))

        square = lambda x: x**2
        total = lambda f, b: lambda a: f(a)+b
        a = int(input("Enter value for a: "))
        b = int(input("Enter value for b: "))
        print(total(square, b)(a))

        Enter the number of meters to be converted: 3
        9.84 feet
        Enter value for a: 10
        Enter value for b: 11
        111

In [15]: from sympy import*
         import random
         import functools
         import operator
         def smart(fun):
             def inner(a,b):
                 if a<b:
```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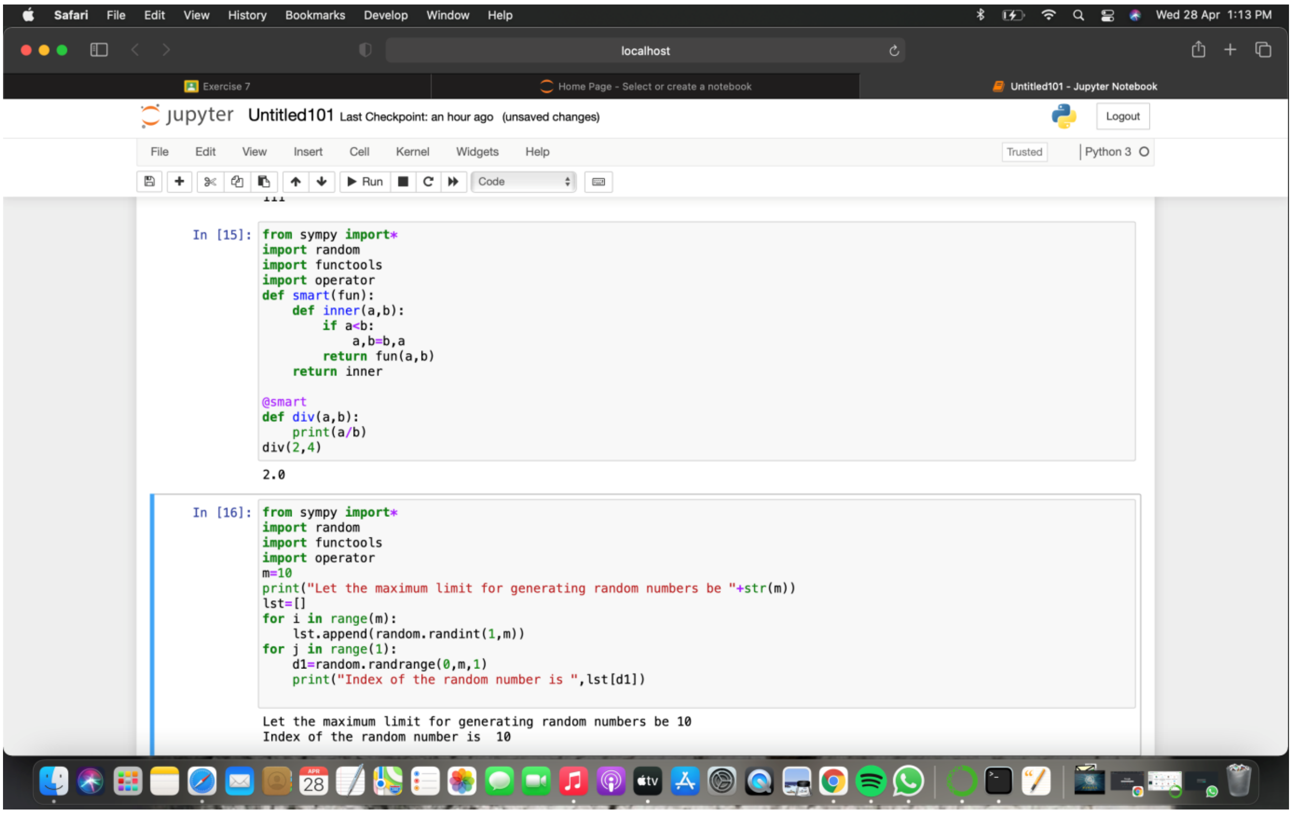
Code

In [9]:
```
feet = lambda m: m*(3.281)
meters = int(input("Enter the number of meters to be converted: "))
print("{:0.2f} feet".format(feet(meters)))

square = lambda x: x**2
total = lambda f, b: lambda a: f(a)+b
a = int(input("Enter value for a: "))
b = int(input("Enter value for b: "))
print(total(square, b)(a))
```

```
Enter the number of meters to be converted: 3
9.84 feet
Enter value for a: 10
Enter value for b: 11
111
```

In [15]:
```
from sympy import*
import random
import functools
import operator
def smart(fun):
    def inner(a,b):
        if a<b:
            a,b=b,a
        return fun(a,b)
    return inner

@smart
def div(a,b):
    print(a/b)
div(2,4)
```

```
2.0
```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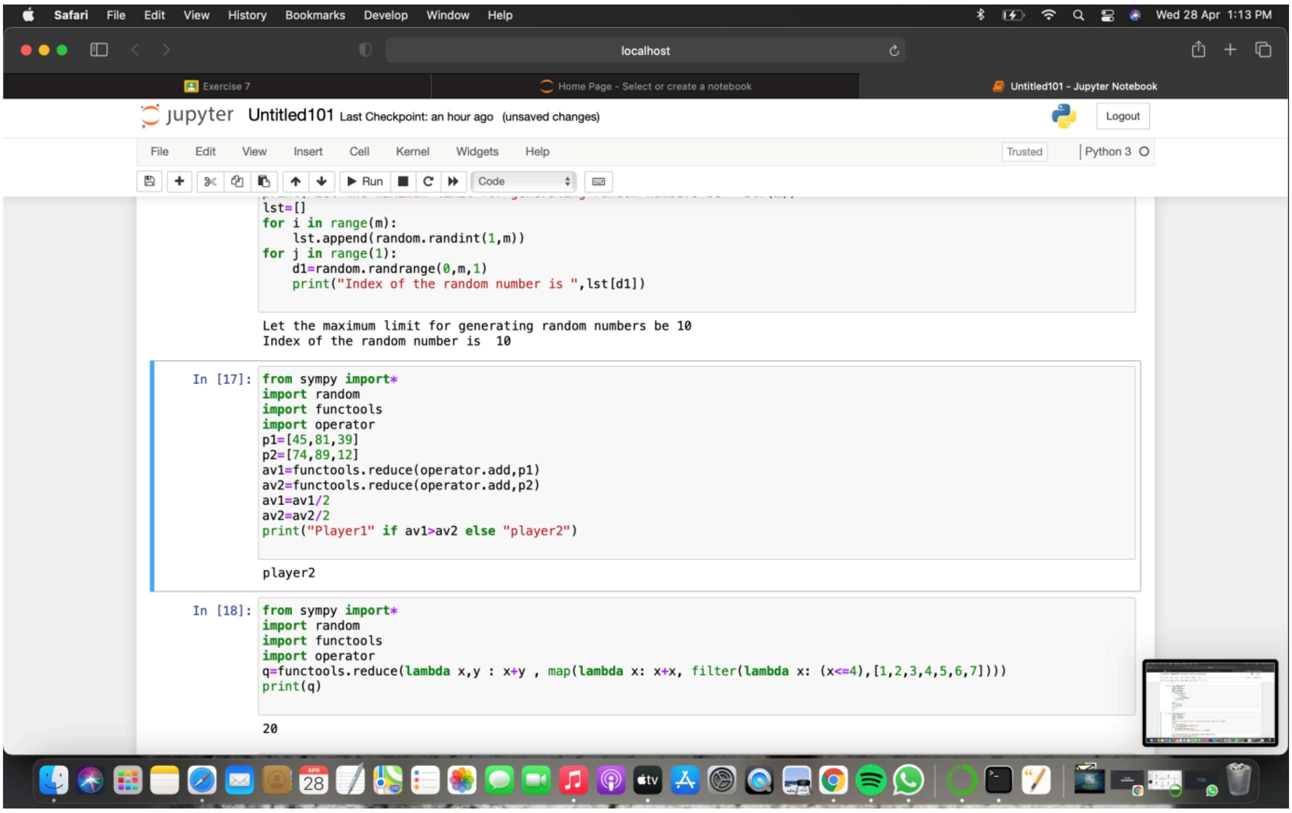
In [15]:
```
from sympy import*
import random
import functools
import operator
def smart(fun):
    def inner(a,b):
        if a<b:
            a,b=b,a
        return fun(a,b)
    return inner

@smart
def div(a,b):
    print(a/b)
div(2,4)
```

```
2.0
```

In [16]:
```
from sympy import*
import random
import functools
import operator
m=10
print("Let the maximum limit for generating random numbers be "+str(m))
lst=[]
for i in range(m):
    lst.append(random.randint(1,m))
for j in range(1):
    d1=random.randrange(0,m,1)
    print("Index of the random number is ",lst[d1])
```

```
Let the maximum limit for generating random numbers be 10
Index of the random number is  10
```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Code

```
lst=[]
for i in range(m):
    lst.append(random.randint(1,m))
for j in range(1):
    d1=random.randrange(0,m,1)
    print("Index of the random number is ",lst[d1])
```

```
Let the maximum limit for generating random numbers be 10
Index of the random number is  10
```

In [17]:

```
from sympy import*
import random
import functools
import operator
p1=[45,81,39]
p2=[74,89,12]
av1=functools.reduce(operator.add,p1)
av2=functools.reduce(operator.add,p2)
av1=av1/2
av2=av2/2
print("Player1" if av1>av2 else "player2")
```

```
player2
```

In [18]:

```
from sympy import*
import random
import functools
import operator
q=functools.reduce(lambda x,y : x+y , map(lambda x: x+x, filter(lambda x: (x<=4),[1,2,3,4,5,6,7])))
print(q)
```

```
20
```