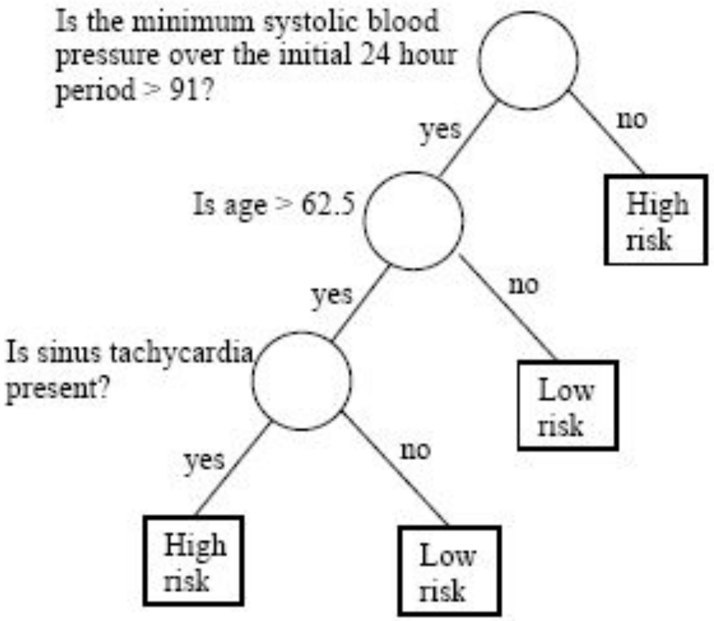
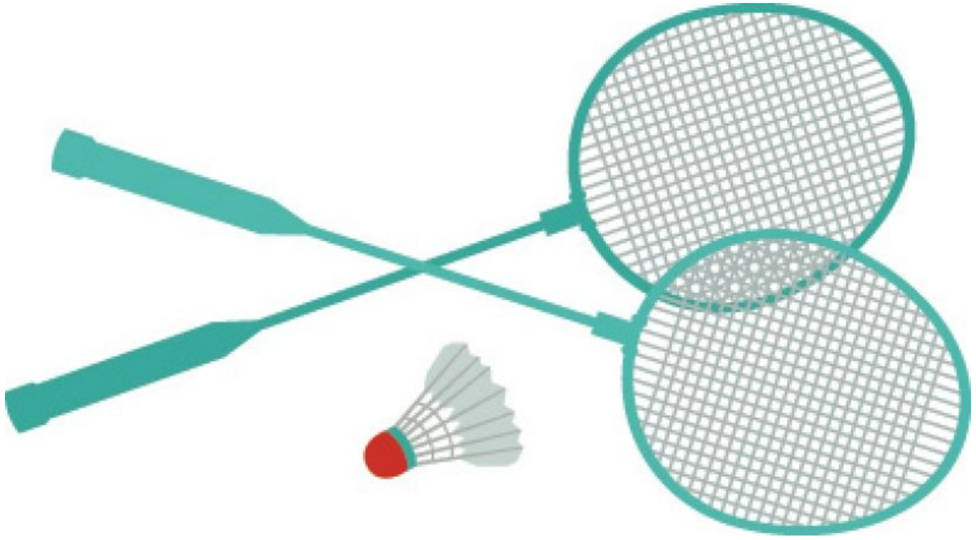
Chapter 8: Boolean Algebra

Feb 25, 2020


Is the minimum systolic blood pressure over the initial 24 hour period > 91?
yes
no
High risk
Is age > 62.5
yes
no
Low risk
Is sinus tachycardia present?
yes
no
High risk
Low risk

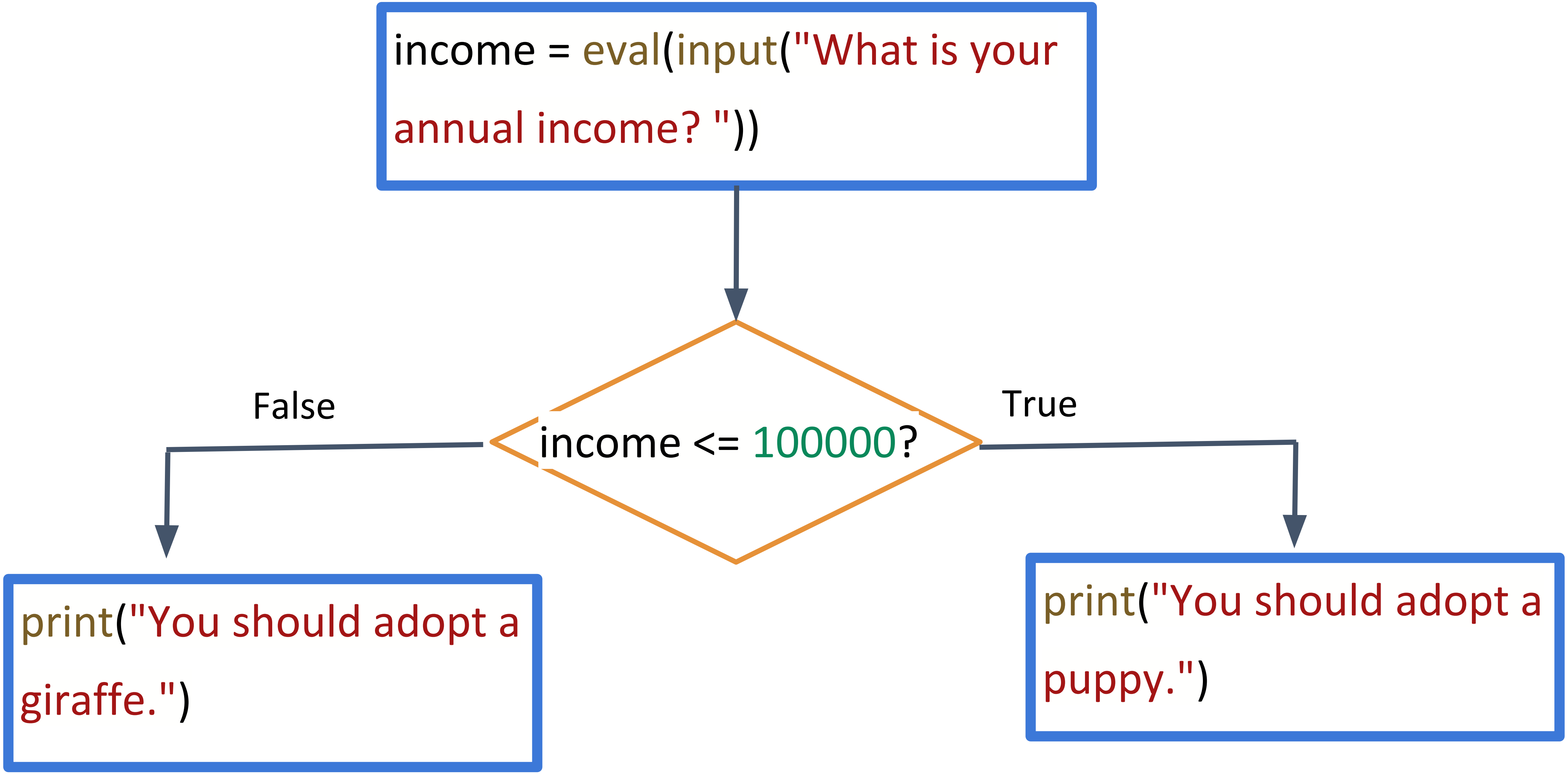


Today’s Outline

- Review:
  - Decision Structures: if statements
  - Exception Handling
- Boolean Algebra
- Midterm Review

If - else statement: 2 way decision

```
#pet income
income = eval(input("What is your annual income? "))

if income <= 100000:
  print("You should adopt a puppy.")
else:
  print("You should adopt a giraffe.")
```



```
income = eval(input("What is your annual income? "))
```

```
income <= 100000?
```

```
print("You should adopt a giraffe.")
```

```
print("You should adopt a puppy.")
```

Multi-Way Decision

```
if <condition 1>:
  <case 1 statement>
elif <condition 2>:
  <case 2 statement>
elif <condition 3>:
  <case 3 statement>
else:
  <default statement>
```

Conditional Program Execution

Sometimes, it may be necessary to create a hybrid module that can both: 1) run as a stand-alone program or 2) can be imported as a library.

```
if __name__ == '__main__':
  print("program is running directly")
  main()
else:
  print("program is not running directly")
```

Exception Handling

If an error occurs while a program is running, it is beneficial for the program to have a mechanism to deal with this error.

Exception Handling

```
try:
  <try to run this code>
except <ErrorType>:
  <run this code if there is an error>
```

Quadratic Code with Error Handling

```
import math
try:
  a = float(input("Enter a value for a: "))
  b = float(input("Enter a value for b: "))
  c = float(input("Enter a value for c: "))
  x1 = (-b + math.sqrt(b**2-4*a*c))/(2*a)
  x2 = (-b - math.sqrt(b**2-4*a*c))/(2*a)
  print("The roots are: {0},{1}".format(x1,x2))
except ValueError:
  print("No real roots.")
```

Multiple Exceptions

```
import math
try:
 a = float(input("Enter a value for a: "))
 b = float(input("Enter a value for b: "))
 c = float(input("Enter a value for c: "))
 x1 = (-b + math.sqrt(b**2-4*a*c))/(2*a)
 x2 = (-b - math.sqrt(b**2-4*a*c))/(2*a)
 print("The roots are: {0},{1}".format(x1,x2))
except ValueError as excObj:
 if str(excObj)== "math domain error":
  print("No real roots.")
 else:
  print("Invalid coefficient provided.")
except:
 print("Oops something went wrong! Sorry")
```

Exception Objects

```
except ValueError as excObj:
  if str(excObj)== "math domain error":
    print("No real roots.")
```

*** Exceptions are a type of object. This code assigns the exception object to the variable excObj. The variable is then converted to a string to check if the message is the math domain error.

Which code can be used to square each item in the list myNums?

a.

```
for item in myNums:
    item = item**2
```

b.

```
for i in range (len(myNums)):
    myNums[i]= myNums[i]**2
```

c.

```
for i in myNums:
    myNums[i] == myNums[i]**2
```

d. a and b

e. all of the above

List Indexing

```
#create a list of squares
myList = []
for i in range(10):
  myList[i] = i**2
print(myList)
```

Option 1: Create placeholders for the list

```
#create a list of squares
myList = [0]*10
for i in range(10):
  myList[i] = i**2
print(myList)
```

Option 2: Append new values to the list

```
#create a list of squares
myList = []
for i in range(10):
  myList.append(i**2)
print(myList)
```

Boolean Algebra

if statements use conditions that are **Boolean expressions**

A Boolean expression can be either: True or False

```
x = 3
print(x ==3)
print(x>5)
```

Bool()

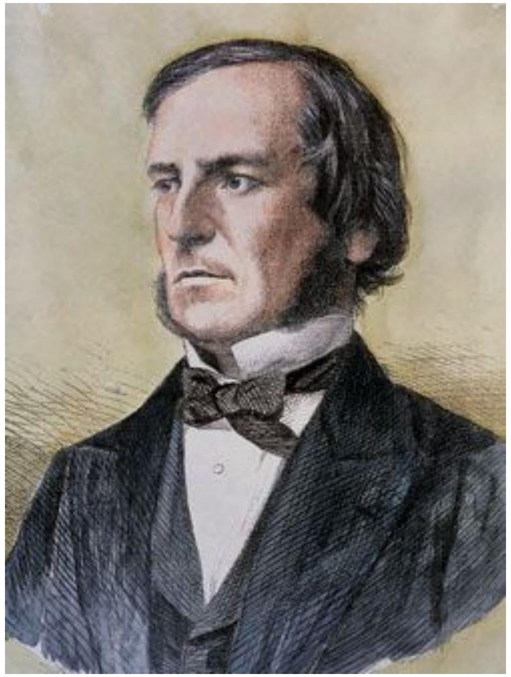
The bool function returns the Boolean of a value or expression (i.e. whether it is True or False).

In Python, any number except 0, and any non-empty string or list is True. Empty lists, strings, 0, and the None object are False.

Bool() Examples

```
bool(None)

bool(4+3==7)

bool("Hello World")

bool(0)

bool("")

bool(False)

bool(True)
```

George Boole (1815-1864)



- Mostly self-taught
  - taught himself Greek, French, and German
  - learned calculus from textbooks
  - interested in philosophy, theology and mysticism
- Developed Boolean algebra
  - values can either be True or False
  - similar to 0s and 1s in computing
- Died of pneumonia

If statement

```
grade = 60
if grade >=50:
  print("Congrats! You passed!")
```

This code means that it will execute the statement print("Congrats! You passed!") if the expression (grade >=50) is True

Boolean Operators: And, Or, Not

All decisions in computer programs are based on Boolean expressions.

The three Boolean operators used in Python are:

1) And
2) Or
3) Not

AND

```
if eggs >= 2 and toast >= 2:
  print("You can make breakfast")

if age >= 18 and citizenship== "Canadian":
  print("You can be an MP")
```

AND Truth Table

P and **Q** represent Boolean expressions.
For example **P** represents (eggs >= 2) and **Q** represents (toast >= 2)

P	**Q**	**P and Q**
T	T	T
T	F	F
F	T	F
F	F	F

AND Truth Table

P and **Q** represent Boolean expressions.
Note: AND is a bit like multiplication.

P	**Q**	**P and Q**
1	1	1
1	0	0
0	1	0
0	0	0

AND logic

What will be the outcome of the following expressions if A, B, and C are Boolean expressions that are True, True, and False respectively?

1. A and True
2. A and False
3. C and True
4. A and B and C

OR

```
if player1_score == 21 or player2_score == 21:
  print("Game Over!")

if eggs < 1 or toast < 1:
  print("You can’t make breakfast.")
```

OR Truth Table

P and **Q** represent Boolean expressions.

P	**Q**	**P or Q**
T	T	T
T	F	T
F	T	T
F	F	F

OR Truth Table

P and **Q** represent Boolean expressions.
Note: OR is a bit like addition

P	**Q**	**P and Q**
1	1	1
1	0	1
0	1	1
0	0	0

OR logic

What will be the outcome of the following expressions if A, B, and C are Boolean expressions that are True, True, and False respectively?

1. A or True
2. A or False
3. C or True
4. A or B or C

NOT

The not operator finds the opposite of a Boolean expression.

not(False) = True

not(True) = False

Not Truth Table

P represents a Boolean expression.

P	**not P**
T	F
F	T

Order of Boolean operations

1. NOT
2. AND
3. OR

A, B, C = True, True, False

A or not B and C

Order of Boolean operations

1. NOT
2. AND
3. OR

A, B, C = True, True, False

A or not B and C

A or [(not B) and C]

Volleyball Scores

In volleyball, the first team to reach 25 points wins. However, the team must win by 2 points.

Write a condition to determine when a volleyball game is over.

Volleyball Scores 2

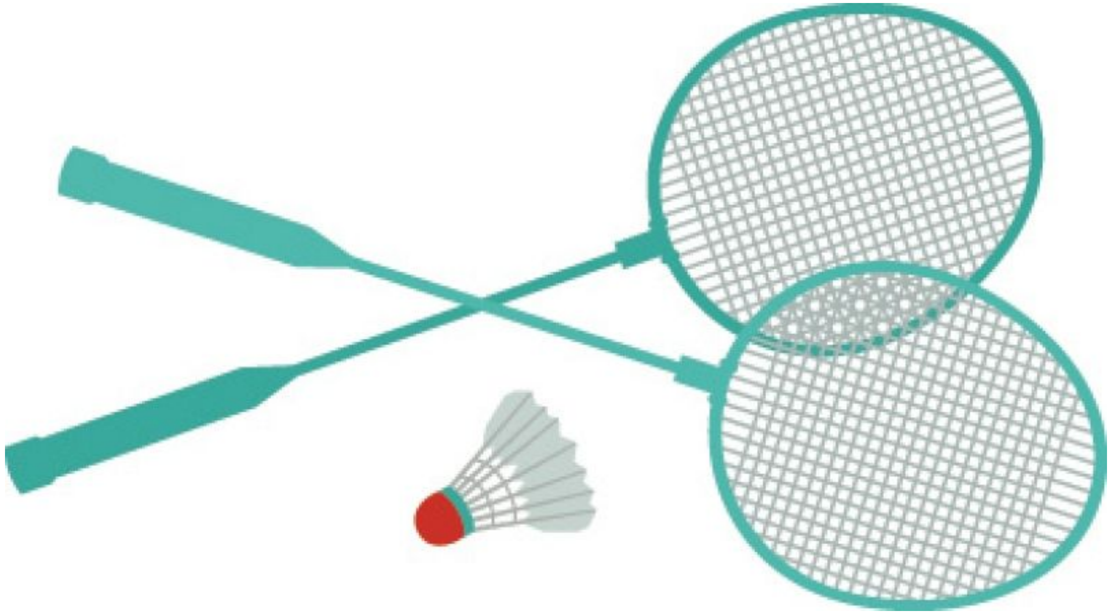
A volleyball league decides that they will also end a volleyball game if the score of the game is 12-0.

Write a condition to determine when the volleyball game is over.

Badminton Scores

In badminton, the first player to reach 21 points wins the match, however the player must win by 2 points. If the players become tied at 29-all, the player that wins the 30th point wins the match.

Write a condition to determine when a badminton match is over.



Midterm

Note: No Quiz this week

Remember that the midterm is coming up on **Friday February 28**.

Topics: Chapters 1-7

Understand: Example Programs and Labs

Note: You can bring all of your notes and solved example programs to the Midterm, so you don’t need to memorize anything!

Topics we learned

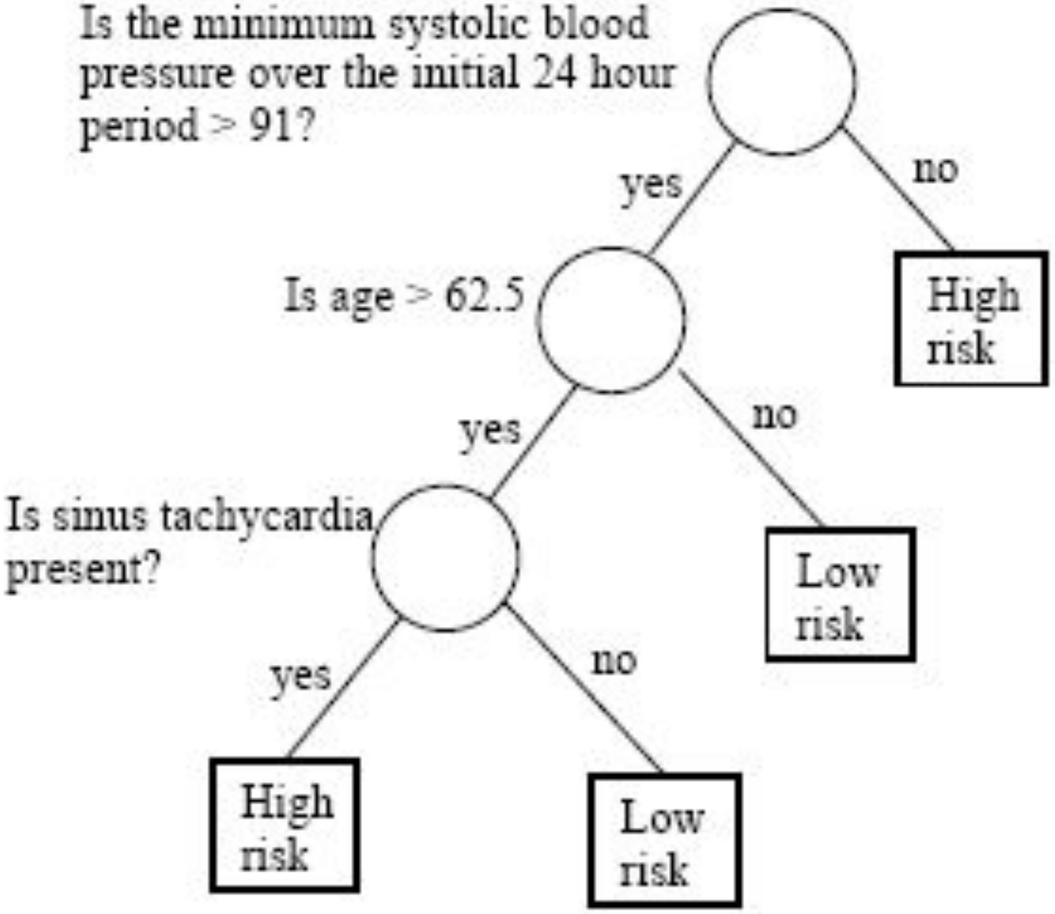
1. Simple programs: variables, functions, for loops
2. Numbers : data types (floats and ints), math library
3. Object oriented programming (classes, methods, objects)
4. Graphics library
5. Sequences (strings, lists, files)
6. Decision structures and exception handling

7. Decision Structures

Credit card numbers follow a standard system. Visa, MasterCard, and Discover Card all have 16 digits, and the first digit serves to indicate the card brand. All Visa cards start with a 4; MasterCard cards always starts with a 5; and Discover cards start with a 6. Write a program that prompts for a credit card and emits the name of the brand. If the card brand cannot be determined, the program should output “Unknown Card.”

Decision Tree

Write a program that prompts a doctor for patient information to determine if a patient is at low risk or high risk.


Is the minimum systolic blood pressure over the initial 24 hour period > 91?
yes
no
High risk
Is age > 62.5
yes
no
Low risk
Is sinus tachycardia present?
yes
no
High risk
Low risk

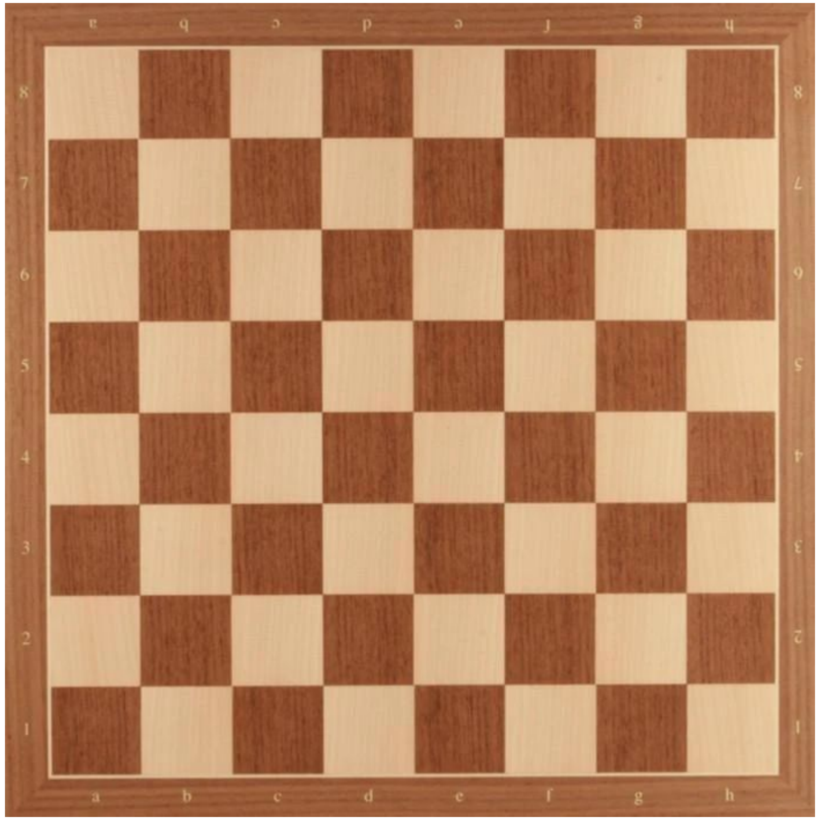
1: Simple Programs Review

1. Write a program that prints the squares of the integers from 1 to 10.

2. Write a program that accepts a value of *n* from the user, and prints the sum of the squares of the integers from 1 to *n*.

3: Working with Numbers

If a chessboard were to have wheat placed upon each square such that one grain were placed on the first square, two on the second, four on the third, and so on (doubling the number of grains on each subsequent square), how many grains of wheat would be on the chessboard at the finish? There are 64 squares on a chess board.



NASA

Write a program which prompts for three different numbers, as a simulation of three different computational results. If at least two of the inputs are the same, your program should output that value. If all three inputs are different, output the word “ERROR” instead.