

The Machine Learning Paradigm

From coding to learning...



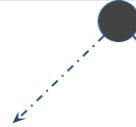
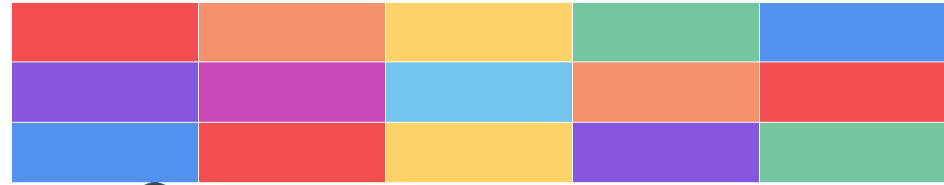
Laurence Moroney, Google

Explicit Coding

Defining rules that determine behavior of a program

Everything is pre-calculated and pre-determined by the programmer

Scenarios are limited by program complexity



```
if (ball.collide(brick)){  
    removeBrick();  
    ball.dx = 1.1*(ball.dx);  
    ball.dy = -1*(ball.dy);  
}
```



The Traditional Programming Paradigm



Consider Activity Detection



```
if(speed<4){  
    status=WALKING;  
}
```

Consider Activity Detection



```
if(speed<4){  
    status=WALKING;  
}
```



```
if(speed<4){  
    status=WALKING;  
} else {  
    status=RUNNING;  
}
```

Consider Activity Detection



```
if(speed<4){  
    status=WALKING;  
}
```



```
if(speed<4){  
    status=WALKING;  
} else {  
    status=RUNNING;  
}
```



```
if(speed<4){  
    status=WALKING;  
} else if(speed<12){  
    status=RUNNING;  
} else {  
    status=BIKING;  
}
```

Consider Activity Detection



```
if(speed<4){  
    status=WALKING;  
}
```



```
if(speed<4){  
    status=WALKING;  
} else {  
    status=RUNNING;  
}
```



```
if(speed<4){  
    status=WALKING;  
} else if(speed<12){  
    status=RUNNING;  
} else {  
    status=BIKING;  
}
```

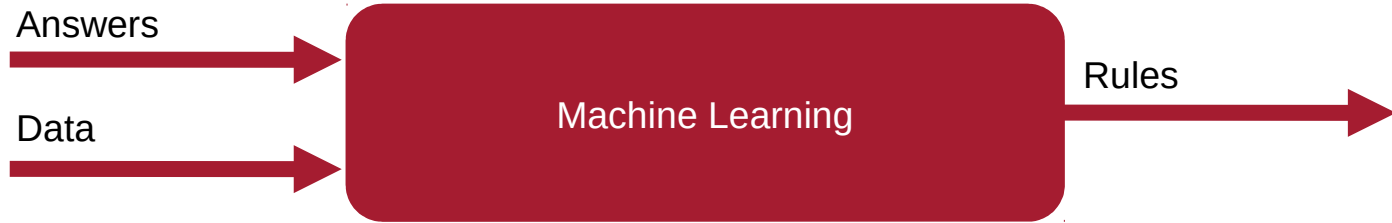


```
// ???
```

The Traditional Programming Paradigm



The Machine Learning Paradigm



Activity Detection with Machine Learning



```
0101001010100101010  
1001010101001011101  
0100101010010101001  
0101001010100101010
```

Label = WALKING



```
1010100101001010101  
0101010010010010001  
0010011111010101111  
1010100100111101011
```

Label = RUNNING



```
1001010011111010101  
1101010111010101110  
1010101111010101011  
1111110001111010101
```

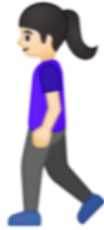
Label = BIKING



```
1111111111010011101  
0011111010111110101  
0101110101010101110  
10101010100111110
```

Label = GOLFING

The Machine Learning Paradigm



```
0101001010100101010  
1001010101001011101  
0100101010010101001  
0101001010100101010
```

Label = WALKING



```
1010100101001010101  
0101010010010010001  
0010011111010101111  
1010100100111101011
```

Label = RUNNING



```
1001010011111010101  
1101010111010101110  
1010101111010101011  
1111110001111010101
```

Label = BIKING



```
1111111111010011101  
0011111010111110101  
0101110101010101110  
10101010100111110
```

Label = GOLFING

The Machine Learning Paradigm



```
0101001010100101010  
1001010101001011101  
0100101010010101001  
0101001010100101010
```

Label = WALKING



```
1010100101001010101  
0101010010010010001  
0010011111010101111  
1010100100111101011
```

Label = RUNNING



```
1001010011111010101  
1101010111010101110  
1010101111010101011  
1111110001111010101
```

Label = BIKING



```
1111111111010011101  
0011111010111110101  
0101110101010101110  
10101010100111110
```

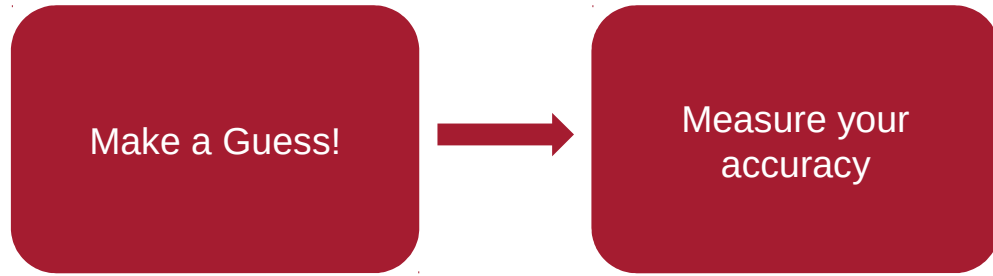
Label = GOLFING

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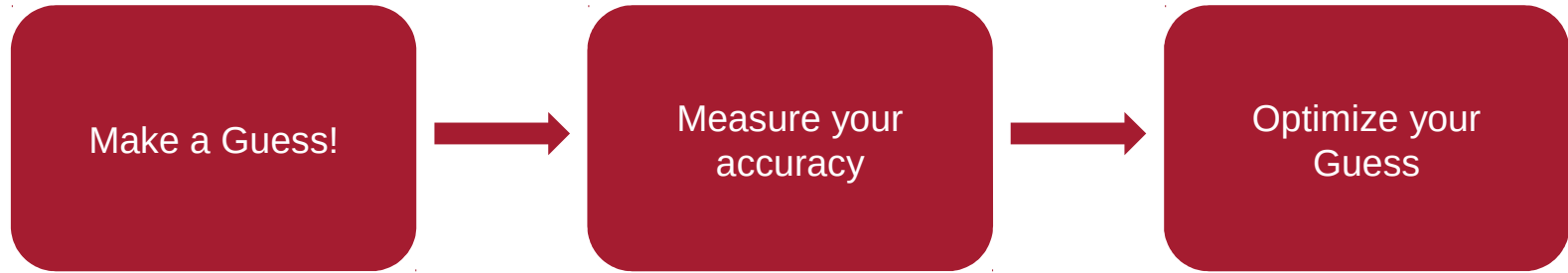


Make a Guess!

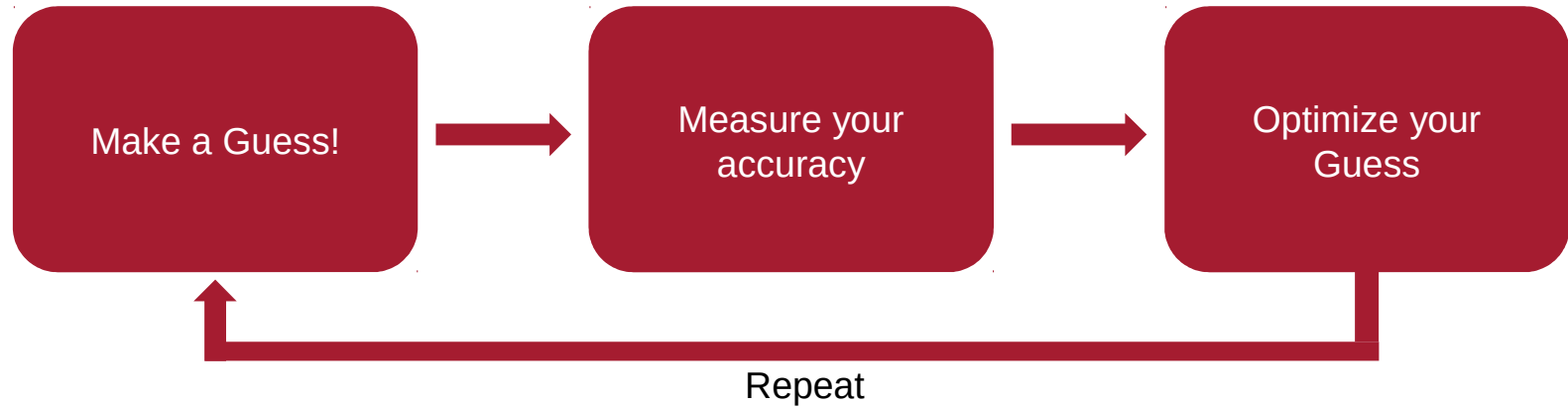
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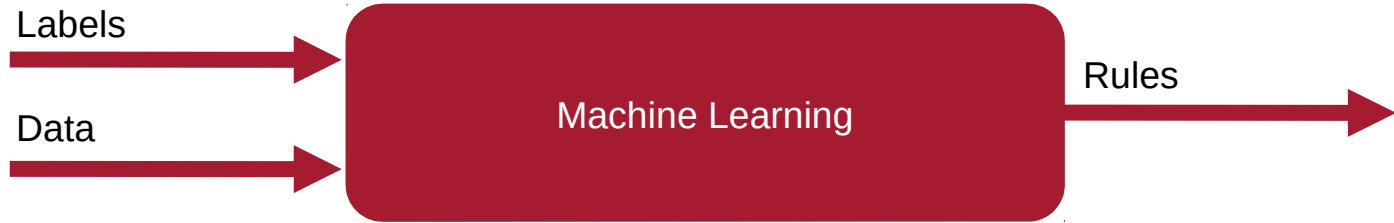
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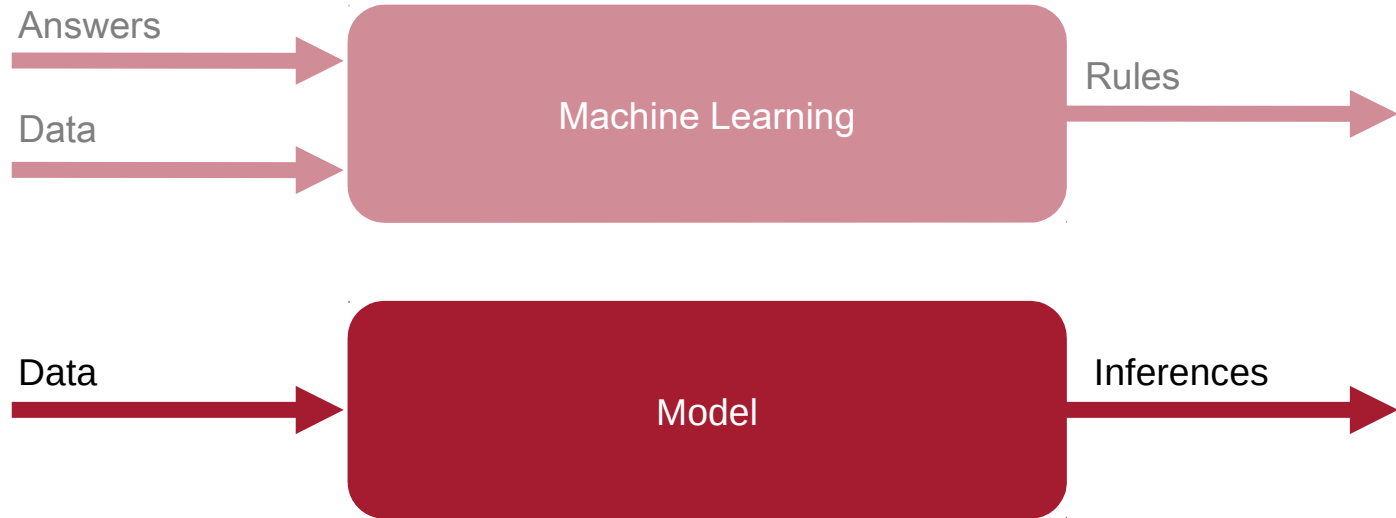
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Your turn!