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Scratch Programming
Lesson 4: Multiple Choice Decisions

Problem
- Write a script to display a letter grade based on a numeric score a student received in a class where the typical scale is used.
- For example: a 97 gets an A; a 72 gets a C

Essence of the Problem
- The script must decide what letter grade to assign

Lets try out a full multimedia version of the code: Demo: Grading
Essence of the Problem

- The script must **decide** what letter grade to assign
- Or put another way, it must **decide** whether or not to give an A; **decide** whether or not to give a B and so on
- What do you use in Scratch to decide things?

The Simple Stuff

- Variable: **Score**
The Simple Stuff

- Variable: Score
  
  person’s numeric score

---

The Simple Stuff

- Variable: Score
  
  Start & Input:
**The Simple Stuff**
- Variable: Score
- Start & Input: Ask for Score
- Output: Say Letter

**The Decisions**
- Decide if they get an A:
The Decisions

- Decide if they get an A:
  - appropriate condition?

- Decide if they get an B:
  - Pretty much the same
The Decisions

- Decide if they get an B:
  ```
  if Score > 80
  say You got a B for 5 secs
  ```

- Decide if they get an C:
  ```
  if Score > 70
  say You got a C for 5 secs
  ```

- Only two letters left.
  What structure can we use to decide between two options?
The Decisions

- Only two letters left. What structure can we use to decide between two options?

- Only two letters left. Condition?

- Only two letters left.
The Complete Script

Four separate IFs

Demo: Grading 1

Fixing the Script

- What is wrong?

- Scripts always run all the way through.

Fixing the Script

- What is wrong?

- Scripts always run all the way through. Just because the first IF figured out an A should be said, doesn’t mean the code stops.
Fixing the Script

- What is wrong?

- Scripts always run all the way through. Just because the first IF figured out an A should be said, doesn’t mean the code stops. The code still goes on to the 2nd IF and then the 3rd and so on.

Fixing the Script

- So lets consider the 2nd decision carefully:

```
if Score > 80
say You got a B for 5 secs
```

See anything wrong here?

Fixing the Script

- So lets consider the 2nd decision carefully:

```
if Score > 80
say You got a B for 5 secs
```

Works for 84.

Fixing the Script

- So lets consider the 2nd decision carefully:

```
if Score > 80
say You got a B for 5 secs
```

Works for 84. Works for 86.
Fixing the Script

- So let's consider the 2nd decision carefully:

```plaintext
if Score > 80
    say You got a B for 5 secs
```

What about 92?

Whoops!

Fixing the Script

- We have not been precise enough.

```plaintext
if Score > 80
    say You got a B for 5 secs
```

The condition is not exactly right.

Fixing the Script

- What must be true about the score?

```plaintext
if Score > 80
    say You got a B for 5 secs
```

Yes it must be more than 80...
Fixing the Script

- What must be true about the score? Yes it must be more than 80 but also less than 90.

\[
\text{if } \text{Score} > 80 \\
\text{say } \text{You got a B for 5 secs}
\]

Fixing the Script

- Yes it must be more than 80 but also less than 90. Both of these conditions must be true.

\[
\text{if } \text{Score} > 80 \\
\text{say } \text{You got a B for 5 secs}
\]

What do you use to combine two conditions together ...

Use an AND

\[
\text{if } \text{Score} > 80 \text{ and Score < 90} \\
\text{say } \text{You got a B for 5 secs}
\]
Fixing the Script

- Yes, it must be more than 80… but also less than 90. Both of these conditions must be true.

Use an AND

Fixing the Script

- Let’s adjust the other two conditions also
  - A C is above 70 but also less than 80

Fixing the Script

- Let’s adjust the other two conditions also
  - A D is above 60 but also less than 70

Revised Script

- A?
  - B?
  - C?
  - D?
  - or F?
Revised Script

Demo:
Grading 2

Fixing the Script Again

- Close but not quite.

Fixing the Script Again

- Close but not quite. Now what is wrong?

Fixing the Script Again

- Close but not quite. Now what is wrong? Remember, just because an earlier IF is true and causes a grade to be said - this doesn’t mean the script stops.

Fixing the Script Again

- Close but not quite. Now what is wrong? Remember, just because an earlier IF is true and causes a grade to be said - this doesn’t mean the script stops. It eventually makes it to the 4th decision (IF) where the F seems to be said too. Why?
Fixing the Script Again

- Even after the A is said, it still eventually makes it to the 4th decision (IF) where the F seems to be said too. Let’s look at this 4th IF.

Fixing the Script Again

- It’s an IF/ELSE. Is it ever possible for an IF/ELSE to do nothing? NO!

Fixing the Script Again

- It’s an IF/ELSE. Is it ever possible for an IF/ELSE to do nothing? NO! It always does one of its two parts.
Fixing the Script Again

- Is it ever possible for an IF/ELSE to do nothing? NO! It always does one of its two parts. So either a D or F will always print!

```
if Score > 60 and Score < 70
say you got a D for 5 sec
else
say you got an F for 5 sec
stop script
```

Fixing the Script Again

- So either a D or F will always print! Every time we run this script, no matter what else it does - a D or F will always be the last item to print.

```
if Score > 60 and Score < 70
say you got a D for 5 sec
else
say you got an F for 5 sec
stop script
```

Fixing the Script Again

- How can we fix this?

```
if Score > 60 and Score < 70
say you got a D for 5 sec
else
say you got an F for 5 sec
stop script
```

Fixing the Script Again

- How can we fix this? Lets not use and IF/ELSE.

```
if Score > 60
say you got a D for 5 sec
else
say you got an F for 5 sec
stop script
```

Fixing the Script Again

- How can we fix this? Lets not use and IF/ELSE. We can break this into two separate regular IFs (like we did for the earlier grades.)

```
if Score > 60
say you got a D for 5 sec
else
if Score < 60
say you got an F for 5 sec
else
say you got a D for 5 sec
end if
say you got an F for 5 sec
stop script
```
Fixing the Script Again

- Two separate regular IFs. No ELSE used.

Latest Script

Five Separate IFs

Three of them had to use ANDs

Bit more complicated than our first attempt.

Latest Script

Demo: Grading 3
Latest Script

Demo:
Grading 3
It finally works right.

Reviewing The Issue

- There was a fairly simple problem. Assign a letter grade given a numeric score.
- Our original code seemed simple enough. But the simple approach just didn’t work well.
- In the end, to get it to work right, we needed five separate IF statements, many of which needed to use AND conditions.

Insight

- The main issue is each IF is a separate statement - each making its own decision. So, that means more than one of them can come out TRUE.
- But, we don’t want more than one to be TRUE.
Insight

- The main issue is each IF is a separate statement - each making its own decision. So, that means more than one of them can come out TRUE.
- But, we don’t want more than one to be TRUE.
- We have a five way decision. We want exactly one of five possible grades to be assigned.
- Yet, IF/ELSEs by their nature, can only make a two way decision.

Another Approach

- Lets look at the skeleton of an IF/ELSE that makes a two-way decision but assigns the right grade.

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- Lets look at the skeleton of an IF/ELSE that makes a two-way decision but assigns the right grade.

```
if Score > 90
  say You got an A for 5 secs
else
  Indicate which of the other grades the person gets
```

Side Lesson

- What statements can you place inside the sections of an IF/ELSE statement?

```
if
else
```

Side Lesson

- But an IF statement is a type of statement.

```
if
else
```

Answer: any type of statement can be placed here.
Example: Problem

- Tuesday is a special day at a movie theater. Everyone gets in for $6, gets a free drink of their choice, and kids under 10 years old, get a free gift.

Example: Code Segment

- Tuesday is a special day at a movie theater. Everyone gets in for $6, gets a free drink of their choice, and kids under 10 years old, get a free gift.

Example: Focus on Toy

- Not everyone gets the toy.

Example: Focus on Toy

- Not everyone gets the toy. You only give it to some people.

Example: Focus on Toy

- Not everyone gets the toy. You only give it to some people. You have to decide to give it or not. What do you use in Scratch to make a decision?
Example: Focus on Toy

- Not everyone gets the toy. You only give it to some people. You have to decide to give it or not. What do you use in Scratch to make a decision? Use an IF.

Example: Focus on Toy

- Use an IF. What is our condition? What has to be true about the person for them to get a toy?

Example: Focus on Toy

- Use an IF. What is our condition? What has to be true about the person for them to get a toy?

Example: Code Segment

- Tuesday is a special day at a movie theater. Everyone gets in for $6, gets a free drink of their choice, and kids under 10 years old, get a free gift.

Example: Code Segment

- Tuesday is a special day at a movie theater. Everyone gets in for $6, gets a free drink of their choice, and kids under 10 years old, get a free gift.

We have to use the code we just created for the toy here.

Back to our main theater code.
Example : Code Segment

- Tuesday is a special day at a movie theater. Everyone gets in for $6, gets a free drink of their choice, and kids under 10 years old, get a free gift.

Here we have an IF

This is called a nested IF

Example : Code Segment

- Tuesday is a special day at a movie theater. Everyone gets in for $6, gets a free drink of their choice, and kids under 10 years old, get a free gift.

Here we have an IF inside another IF

Back To Grading

- Let's look at the skeleton of an IF/ELSE that makes a two-way decision but assigns the right grade.

So, how do this?

Indicate which of the other grades the person gets

Back To Grading

- Let's look at the skeleton of an IF/ELSE that makes a two-way decision but assigns the right grade.

We can use a nested IF

Indicate which of the other grades the person gets

Put code for other grades in the ELSE section of our A? IF.
Back To Grading

- Put code for other grades in the ELSE section of our A? IF.

Code for all other grades: Either a B or the rest

Back To Grading

- This is a nested IF.

Code to give C or other grade

Back To Grading

- This is a nested IF. You can nest more than once.

Back To Grading

- This is a nested IF. You can nest more than once.

Back To Grading

- This is an IF inside an IF inside an IF.

Back To Grading

- One last time:

Give D or F
Back To Grading

- One last time:
  - Note: This is one big IF statement
  - Not five separate statements like before

Note: This is one big IF statement
As such, it is impossible for more than one grade to be assigned.
Back To Grading

- Note: This is one big IF statement
- As such, it is impossible for more than one grade to be assigned.
  - The one main IF either says A or (else section) assigns one other grade

Back To Grading

- Note: This is one big IF statement
- No ANDs needed.

Complete Code

Complete Code

Demo: Grading 4

Main Point

- We already knew you use a regular IF if you want to choose between doing something or skipping it.
- And, if you need to choose between two things to do, and you definitely want to do one of those two things, you use an IF/ELSE
Main Point

- We already knew you use a regular IF if you want to choose between doing something or skipping it.
- And, if you need to choose between two things to do, and you definitely want to do one of those two things, you use an IF-ELSE
- Now we know, if you have more than two choices - a multiple choice decision - and you want to do exactly one of the choices, then use NESTED IFs

Main Point

For multiple choice decisions, use NESTED IFs

One Last Fix

- Most people think of exactly 90 as an A, and exactly an 80 as a B.
- What does our code do? Let's go see.

One Last Fix

- Most people think of exactly 90 as an A, and exactly an 80 as a B.
- What does our code do? Let's go see.
- Some of you already noticed this.
- How do we fix this?

One Last Fix

- Most programming languages have more relational operators, similar to what you learned long ago in math class. Like:
  - IF Score >= 90

One Last Fix

- Most programming languages have more relational operators, similar to what you learned long ago in math class. Like: Score >= 90
- Scratch does not. So we have to use the logical operators.
One Last Fix

- Most programming languages have more relational operators, similar to what you learned long ago in math class. Like: Score $\geq 90$
- Scratch does not. So we have to use the logical operators.
- For example, assign an A when the grade is over 90 or when the grade is exactly 90.

One Last Fix

- For example, assign an A when the grade is over 90 or when the grade is exactly 90.
- If either one of those two possibilities is true, we should give an A.
- What logical (boolean) operator do you use when just one of two possibilities has to be true? OR

One Last Fix

- For example, assign an A when the grade is over 90 or when the grade is exactly 90.
- If either one of those two possibilities is true, we should give an A.
- What logical (boolean) operator do you need just one of two possibilities has to be true? OR

if Score > 90 or Score = 90

say You got an A for $\#$

else


Code to Handle Exact Scores
Notice ORs

Code to Handle Exact Scores
Notice ORs

Code to Handle Exact Scores
Notice ORs
Demo: Grading 5

Adding Multimedia
- Stage
- Costumes
- Sounds
Adding Multimedia

- Change costume, play appropriate sound when grade is assigned.

Code With Multimedia Included

Demo: Grading

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