computing: nature, power and limits—robotics applications (cis1.0)
fall 2006—lecture # F1
monday 13-nov-2006

today:

- *review:*
  - event-driven programming
  - conditional execution
  - conditional repetition
- *new:*
  - programmer-defined functions

event-driven programming

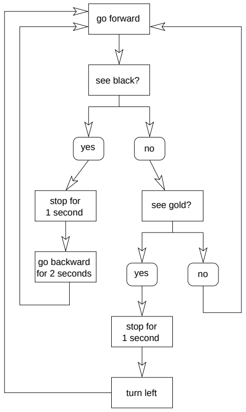
- when web pages are *event-driven*, that means that they respond to input from a user
- when a robot's behavior is *event-driven*, that means that it responds to input from its sensors
- in RoboLab, the following icons facilitate *event-driven* behavior in your robot:
  wait-for-let-go *wait-for-push* *wait-for-light* *wait-for-dark*
- the robot *waits for* an event to happen, then it executes the icons that follow the "wait for" icon in your code
- remember that this doesn't mean that the robot sits still—if you give it motor commands, like *forward* , before the "wait for" icon, then your robot will go forward until the "wait for" event happens

conditional execution

- there are times when you want your code to behave differently under different conditions
- for example, in the assignment for unit E:
  IF your robot sees something black, THEN it should stop for one second, then go backwards for two seconds, then go forward again.
  IF your robot sees something silver or gold, THEN it should stop for one second, then turn to the left and go forward again.
- the notion of *conditional execution* means that you define in your program multiple *branches*, and the code will follow a different branch depending on the conditions it encounters while running
- conditional execution is sometimes referred to as *IF-THEN* or *IF-THEN-ELSE* execution
- if the IF condition is true, then the THEN branch is executed;
  otherwise (if the IF condition is false), the ELSE branch is executed

- in RoboLab, the following icons facilitate *conditional execution* in your robot:
  touch-sensor-fork *light-sensor-fork* *fork-merge*
- note that these are different from *event-driven* icons since the program will NOT wait for an event to happen but will simply evaluate the condition of the *fork* icon and execute a branch accordingly
- for example, when using the *touch-sensor-fork* :
  IF the touch sensor is not pressed when the program comes to the *touch-sensor-fork* icon in its execution,
  THEN the top branch of icons will be executed;
  ELSE the bottom branch of icons will be executed
- when using the *light-sensor-fork* :
  IF the light sensor reads a value greater than the one specified (you have to hang a numeric constant below the icon containing the *threshold value* for the IF-THEN-ELSE decision),
  THEN the top branch of icons will be executed;
  ELSE the bottom branch of icons will be executed

- when writing a program that uses conditional execution, it is often easier to design your code first using a *flowchart*, before trying to write anything on the computer
- for example, here is a flowchart for the last challenge in the assignment for unit E:



conditional repetition

- there are times when you want your code to execute the same thing over and over again, repeatedly
- this is called *looping* or *iteration*
- we talked about three types of loops:
  - "forever" (or *infinite*) loops
  - *counter-controlled* loops
  - *condition-controlled* loops
- in RoboLab, the following icons facilitate infinite loops:

yellow land	*yellow jump*
goes BEFORE the code that you want to repeat	goes AFTER the code that you want to repeat

- in RoboLab, the following icons facilitate counter-controlled loops:

start-of-loop	*end-of-loop*
goes BEFORE the code that you want to repeat	goes AFTER the code that you want to repeat

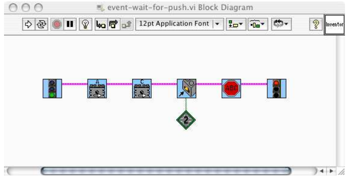
- you have to hang a *loop counter* (numeric constant) from the *start-of-loop* icon indicating the number of times you want the loop to run

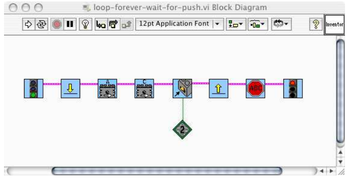
- in RoboLab, the following icons facilitate condition-controlled loops:

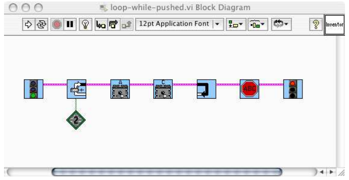
loop-touch-sensor-pushed	*loop-touch-sensor-released*
loop-light-sensor-less-than	*loop-light-sensor-greater-than*

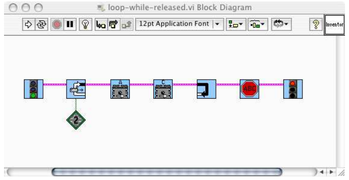
- for the light sensor loops, you have to hang a *loop counter* (numeric constant) from the "start of loop" icon indicating the number of times you want the loop to run
- for all the sensor-based loops, you have to hang the *port number* from the "start of loop" icon indicating which port the sensor is connected to
- for all the loops, the icons above show the "start of loop" icon; to end the loops, you use the *end-of-loop* at the end of the loop

- compare the following programs:



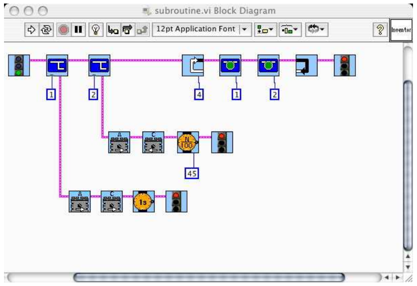






programmer-defined functions

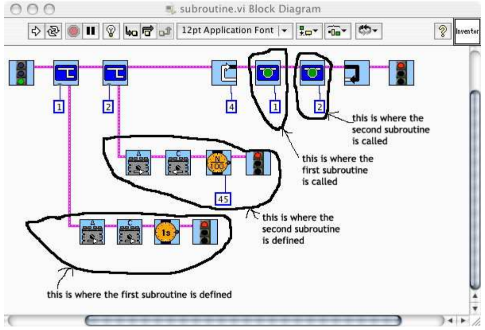
- in RoboLab, "progammer-defined functions" are called *subroutines*
- the idea behind a *subroutine* is if you have some piece of code that is useful and you might want to use it many times—not just in a loop, but other times too—then you can group the icons together into something called a *subroutine*
- example:



- subroutines work by having two parts:
  - first, you have to *define* the subroutine
  - second, you have to *invoke* or *call* the subroutine
  - the subroutine only runs when you *call* it
  - it does NOT run when you *define* it
- the subroutine is defined with the *create-subroutine* icon
- hanging from the *create-subroutine* icon is a numeric constant, assigning a number to the subroutine
- this is in case you want to define more than one subroutine—you give each a number so that you can distinguish between them later
- from the lower right corner of the *create-subroutine* icon, you string the icons that you want to belong to the subroutine
- you end the subroutine with the *end* icon
- from the top right corner of the *create-subroutine* icon, you continue with your program code

- when you want to *call* or *invoke* the subroutine,

  then you use the *run-subroutine* icon
- here's the example again:



this is where the second subroutine is called

this is where the first subroutine is called

this is where the second subroutine is defined

this is where the first subroutine is defined