CPSC 421/501 Sept. 15, 2025

- LanguageRecognizedBy :

$ASCII^* \longrightarrow Power(ASCII^*)$

A finite length ASCII string

interpret as a Python (Javascript, etc.) program

On input $i \in ASCII^*$, program says either { yes / no } or "loops" i.e. not yes, not no

```
# This is a comment
#
def isDivByThree( ):
print("Give me a positive integer.")
i = input("Your input: ")
while( i >0) :  i = i-3
if ( i == 0):
        return( "yes")
return( "no")
```

Just some ASCII string

DIV-BY-3 over $\Sigma = \{0, 1, \ldots, 9\}$

?

- $\{3, 6, 9, 12, 15, \ldots\}$
- $\{0, 3, 6, 9, \ldots\}$
- $\{0, 3, 6, 9, 00, 03, \ldots\}$

etc.

All caps for LANGUAGES

You have to carefully specify what you mean

Python / C++ / APL / ---

Conventions!

A "program" takes an input

$i \in ASCII^*$ =

$ASCII^0 \cup ASCII^1 \cup ASCII^2 \cup \cdots$

{ set of finite length ASCII strings }

Result: "yes"

"no"

"loop" — anything else

```
# This is a comment
#
def isDivByThree( ):
print("Give me a positive integer.")
i = input("Your input: ")
while( i >0) :  i = i-3
if ( i == 0) :
        return ("yes")
return("no")
```

Idea: input 7

i = 7, i = 4, i = 1, i = -2

input 123123, i = 123123, i = 123120

i = 123117, ...

... i = 0

Problem:

On input: "hi"

isDivByThree( )

gives:

Traceback (most recent call last)

...

TypeError ...

```
#  This is a comment
#
def isDivByThree( ):
print("Give me a positive integer.")
i = input("Your input: ")
while( i >0) :  i = i-3
if ( i == 0) :
        return( "yes")
if ( i== -1 or  i== -2)
        return("no")
```

Input i = -3:

i = -6, i = -9, i = -12, ---

does not halt !!

```
# This is a comment
#
def isDivByThree( ):
print("Give me a positive integer.")
i = input("Your input: ")
while( i != 0 or i != -1
       or i != -2)
    i = i-3

if ( i == 0):
    return("yes")
if ( i == -1 or i == -2)
    return("no")
```

return "yes"

return "no"

other: TypeError, never halt...

→ "loops"

Say program $p \in ASCII^*$

accepts i (as an input) if
running p on i returns yes.

rejects i ... — " "
... " " ... no

For each $p \in ASCII^*$, the

language recognized by p,

LanguageRecBy(p), is defined

to be

$$\{ i \in ASCII^* \mid p \text{ accepts } i \}$$

$\subset ASCII^*$, Hence

$LanguageRecBy : ASCII^*$

$\longrightarrow Power(ASCII^*)$

LanguageRecBy(p)

$\stackrel{\text{def}}{=} \{ i \in \text{ASCII}^* \mid p \text{ returns "yes" on input } i \}$

By Cantor's Theorem

$$T = \{ s \in ASCII^* \mid s \notin LanguageRecBy(s) \}$$

is not in the image of

LanguageRecBy (!),

(i.e. $\nexists$ (there does not exist $t \in ASCII^*$ s.t. $T = LanguageRecBy(t)$)

Note: how can you, given, $S \in ASCII^*$, tell if on input S, the program S say yes ??

Is there an algorithm that given S, and given that S says yes or no on S will tell you so in a finite amount of time.

Ans: Yes, you could run "a debuggy

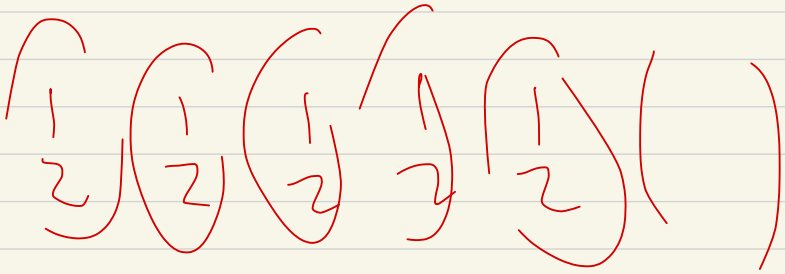
program" or

"universal Python machine"

simulates what s would do

on any input

Course ends



11 → 1

12 → 2

21 → 3

22 → 4