

ECS 120 – Spring 2023 – Quiz #7

Q1

1 Point

Prof. Rogaway tells his cat, Schrödinger, that **every language in PSPACE is decidable**. The cat nods. What should it understand the statement to *mean*? Check all that apply.

If L is in PSPACE then there is a TM M that accepts x iff $x \in L$.

If L is in PSPACE then there is a TM M that accepts each string $x \in L$ and rejects each string $x \notin L$.

There is a TM M that decides if PSPACE is a language.

Note: You are not asked to select the statement(s) that are *true*; you are asked to restate the *meaning* of the professor's claim.

The first choice is what it would mean to say that it's (Turing) acceptable – not what it means to say that it's (Turing) decidable.

The second answer is a perfect translation of what it means to say that it's decidable.

The third answer is total nonsense: “decides if PSPACE (a class of languages, you can infer from the setup) is a language”?!

Q2

1 Point

Mark all of the true statements:

Turing-acceptable languages are Turing-decidable.

Turing-decidable languages are Turing-acceptable.

A language is recursively enumerable (r.e.) if and only if it is recursive.

- An r.e. language might or might not be decidable
- sure
- Not at all: recursive languages are a (proper) subset of r.e. languages, they're not the same thing

Q3

1 Point

Is the language $L = \{a^n b^m : n \neq m\}$ context free?

Mark all correct answers.

No, the context free language we know is $\{a^n b^n : n \geq 0\}$.

Yes, because it's not hard to see that there's a context-free grammar for L .

Yes, because context free languages are closed under complement and L is the complement of the CFL $\{a^n b^n : n \geq 0\}$.

- You know that that language is context free, but how is that responsive / relevant to the question? It's not
- Yep
 $S \rightarrow A T \mid T B$ // excess a's or excess b's
 $T \rightarrow a T b \mid \epsilon$ // eq # of a's and b's
 $A \rightarrow a A \mid a$ // one or more a's
 $B \rightarrow b B \mid b$ // one or more b's
- Wrong both because CFLs are NOT closed under complement (we never claimed they were) and L is not the complement of the language named.

Q4

1 Point

Prof. Rogaway read to class a passage from what sort of book?

A children's book. (Namely, a children's book that Alan Turing read at 10 and liked.)

Q5

2 Points

Which points came up in our discussion of the Church-Turing thesis? Check all that apply.

- TMs can't perform probabilistic computations.
- TMs don't know the time.
- TMs can't communicate with other devices.
- Programs like ChatGPT aren't computing any known, understood function.

Yep, we said all these things and more.

Q6

2 Points

When we write angle brackets in an expression like $\langle M, w \rangle$, what do the angle brackets signify?

It means **an encoding of** (the thing inside the brackets).

Sometimes people say a “natural” encoding.

Said differently: a string that represents, in an unnamed but natural way, whatever is in the angle brackets.

Q7

2 Points

Is the language $\{1^n : n \text{ is prime}\}$ Turing-decidable (recursive)? How do you know?

Yes. You could write a computer program to decide if n (written in unary or binary, it doesn't matter) is a prime. By the Church-Turing thesis (or the digital-modelling thesis), that is enough: you could translate you program to a TM if need be.