X8.0 (talking philosophers) The talking philosophers problem is like the dining philosophers problem, but simpler and more realistic. Two philosophers, Socrates and Plato, are sitting in a room. Each philosopher thinks for a while, and when they have an interesting thought, they say it aloud, and then go back to thinking. But they must not talk at the same time. Here is an attempt at programming it. Let t be time. Let *Stalking* be a binary interactive variable indication that Socrates is talking, and let *Ptalking* be a binary interactive variable indication that Plato is talking. Let *Sthinktime* , *Pthinktime* , *Stalktime* , and *Ptalktime* be random amounts of time that Socrates and Plato are thinking and talking.

life $\Leftarrow$ *Stalking*:= $\bot$. *Ptalking*:= $\bot$. *Socrates* $\|$ *Plato*

Socrates $\Leftarrow$ t:= t+*Sthinktime*.
if $\neg$*Ptalking* **then** *Stalking*:= $\top$. t:= t+*Stalktime*. *Stalking*:= $\bot$
else *ok* **fi**.
Socrates

Plato $\Leftarrow$ t:= t+*Pthinktime*.
if $\neg$*Stalking* **then** *Ptalking*:= $\top$. t:= t+*Ptalktime*. *Ptalking*:= $\bot$
else *ok* **fi**.
Plato

life is the concurrent lives of *Socrates* and *Plato* . Socrates starts by thinking for a while t:= t+*Sthinktime* , and then checks to see if Plato is talking $\neg$*Ptalking* . If not, Socrates indicates that he will talk *Stalking*:= $\top$, then he talks for a while t:= t+*Stalktime* , and then stops talking *Stalking*:= $\bot$. Then the life of Socrates repeats. And similarly for Plato.

(a) What is wrong with this solution?
(b) Write a correct program.

After trying the question, scroll down to the solution.

(a) What is wrong with this solution?

§ It is possible that *Socrates* is checking *Ptalking* just when *Plato* is changing its value, and similarly for *Plato* and *Stalking*. Some books/courses "solve" the problem by defining an atomic action as being an action that cannot be interrupted by a concurrent action. In other words, they push the problem off to the hardware designers. But there's no need for that. The best solution is to write a program that doesn't have the problem.

There is another problem. The random times *Sthinktime*, *Pthinktime*, *Stalktime*, and *Ptalktime* are unchanging times each iteration.

(b) Write a correct program.

§ The incorrect solution offered in the question is complicated and misleading. Here is a solution. Let *thinktime* be a random amount of time that both Socrates and Plato are thinking. Let *Stalktime* be a random amount of time that Socrates is talking. Let *Ptalktime* be a random amount of time that Plato is talking.

life ⇐ *t*:= *t*+*thinktime*. *Socrates* ∨ *Plato*. *life*
Socrates ⇐ *t*:= *t*+*Stalktime*
Plato ⇐ *t*:= *t*+*Ptalktime*

We need to resolve the nondeterminacy (∨) to decide in what order they speak. We could use **or** from Subsection 5.4.0.

Socrates ∨ *Plato* ⇐ *Socrates* **or** *Plato*

If we want the order to conform to a probability distribution, then

Socrates ∨ *Plato* ⇐ **if** *r* **then** *Socrates* **else** *Plato* **fi**

where *r* is a binary probability distribution from Subsection 5.7.0. Likewise we need *thinktime*, *Stalktime*, and *Ptalktime* to be integer probability distributions from Subsection 5.7.0.

We don't want Socrates and Plato to talk concurrently, and in this program there is no concurrency.