Solutions to the Attendance Quiz for Lecture 14 of Dr. Z.'s Dynamical Models in Biology class

Name: Dr. Z.

1.: Use procedurs `SSg`, `SSSg` to find the set of steady-states and stable-steady-states of the system with three species

$$a_1(n+1) = \frac{7+2a_1(n)+a_2(n)+5a_3(n)}{8+7a_1(n)+4a_2(n)+3a_3(n)}$$

$$a_2(n+1) = \frac{2+8a_1(n)+8a_2(n)+3a_3(n)}{4+9a_1(n)+2a_2(n)+2a_3(n)}$$

$$a_3(n+1) = \frac{2+3a_1(n)+2a_2(n)+9a_3(n)}{9+a_1(n)+3a_2(n)+10a_3(n)}$$

Then use procedure `ORB(F,x,x0,K1,K2);` with `K1=1000, K2=1010`, and four different random **x0** (far away from each other) and see whether they all converge to the stable steady-state that you round.

Sol. to 1: The **underling transformation** from R^3 to R^3 is:

$$(x, y, z) \to latex(T); \left[\frac{7+2x+y+5z}{8+7x+4y+3z}, \frac{2+8x+8y+3z}{4+9x+2y+2z}, \frac{2+3x+2y+9z}{9+x+3y+10z}\right]$$

So define `T:=`

`[(7+2*x+y+5*z)/(8+7*x+4*y+3*z), (2+8*x+8*y+3*z)/(4+9*x+2*y+2*z),`

`(2+3*x+2*y+9*z)/(9+x+3*y+10*z)]:`

To get the set of steady-states you type

`SSg(T,[x,y,z]);`

getting:

`[[0.63281473, 1.5021869, 0.6126948139]]` .

To get the set of **stable** steady-states you type

`SSSg(T,[x,y,z]);`

getting again the same thing:

`[[0.63281473, 1.5021869, 0.6126948139]]` .

To check it numerically do, for example (of course there are infinitely many choices):

```
ORB(T,[x,y,z],[10.,20.,40.],1000,1010);
```

```
ORB(T,[x,y,z],[100.,10.,50.],1000,1010);
```

```
ORB(T,[x,y,z],[3.,4.,100.],1000,1010);
```

and you see the orbits always converge to this steady-state, confirming, numerically, that it is stable.