

Interagency

...

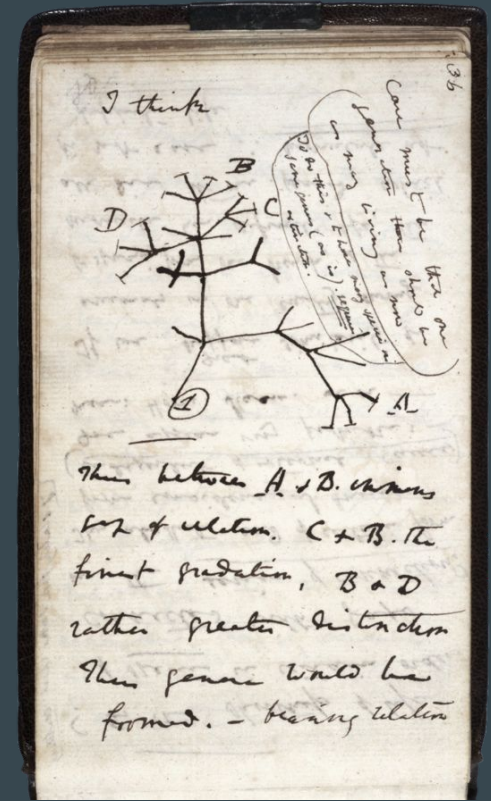
Luke Demarest and Sam Ludford

Conceptualising the Nonhuman

The situation of humans within the world has shaped the development of our conceptual apparatus.

We live at a certain time in history, experience the world on particular temporal and spatial scales, and are equipped with only the capacities history has left us with.

We are not passive observers but beings with interests, agents acting on and within the world.



"I believe this simile largely speaks the truth"
Darwin, 1859

The “knower” does not stand in a relation of absolute externality to the natural world being investigated - there is no such exterior observational point. [...] “We” are not outsider observers of the world. Nor are we simply located at particular places *in* the world; rather, we are part *of* the world in its ongoing intra-activity.

Karen Barad - Posthuman Performativity: Toward an Understanding of How Matter Comes to Matter

Tools and Representations

Our theories and concepts cannot only represent the world, they must be useful to us in our interactions with it. In the first instance, concepts are *tools*.

Utility and representational accuracy may or may be in conflict, and the relationship between them will often be complex. Hammers do not represent nails, whereas a map is a tool that owes its utility to the fact that it represents.

When thinking about the concept of agency we will approach it first as a tool, asking what it is that we are doing when we attribute agency both to humans and nonhuman systems.

Agency (and its Absence) in Nature

Historically humans have explained natural phenomena by appeal to hidden agencies, e.g. crop failures, volcano eruptions, and spontaneous locust migrations.

As better understandings of the causal mechanisms underlying natural processes have been developed these natural agencies have disappeared.

Humans are as entwined in the causal net as anything else in the natural world, and so are susceptible to the same analyses.

Isn't human agency also an illusion, a fanciful metaphor for what is really just a complex system of deterministic processes grinding away blindly?



Useful Fictions

Even if it were conceded that human agency a fiction, it seems unlikely anyone would suggest that we stop treating each other as beings with interests and agendas.

There are also many cases where treating nonhuman systems as agents has proved extremely useful in understanding their behaviours, e.g. genes, countries.

At the very least, agency is a useful concept for describing both human and nonhuman systems, regardless of whether we find ontological significance in that utility.

If deterministic arguments threaten agency in the natural world then they do so in the human also. If humans are agents then there's no reason to suppose nonhuman systems cannot be.

Why does Agency Matter?

To take nonhuman systems seriously as agents is to recognise that they have interests which may not reduce to the interests of the humans that observe, compose, or create them.

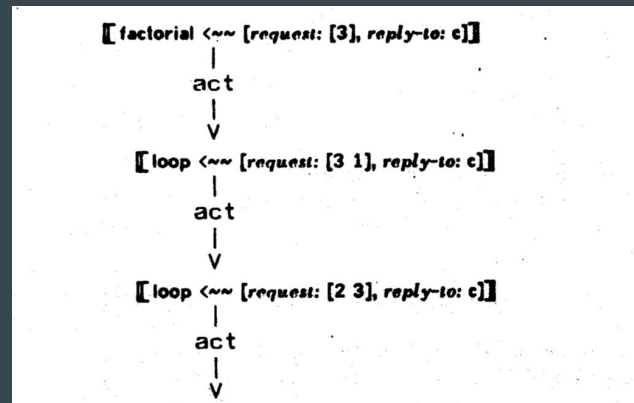
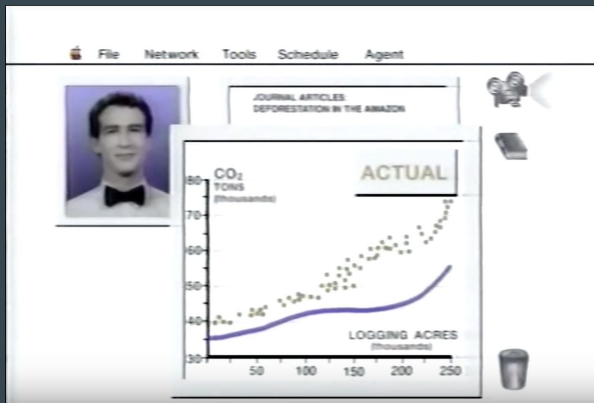
The relevance of this is particularly vivid in the case of software.

On the one hand it is not common to regard computational processes as agents. On the other, we live in a world where more and more responsibilities are parcelled out to computational systems, systems whose influence is no longer confined to the digital domain. Internet of things, smart environments, etc.

A supposedly “natural” setting turns out to be nothing if not a highly artificial context or an information-intensive environment, and it appears attentively oriented towards us rather than being neutral or perfectly non-caring. [...] Then, we are also, and not least, disturbed by vestiges of autonomy, artificial intelligence, and artificial life.

Software Agents

The notion of a software “actor” was developed in the 1970’s, and was seen as a useful abstraction for encapsulating behaviour in communicating parallel processes.



Carl Hewitt - Actors and Continuous Functionals

In 1987 Apple released Knowledge Navigator, a concept video imaging the relationship between humans and software agents in the future.

An *autonomous agent* is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future.

Features of Agency

For a system to be considered an agent it must

1. Be embedded in an environment
2. Possess operational autonomy
3. Sense this environment
4. Act on this environment
5. Possess a future-directed agenda which structures the relationship between what it senses and how it acts

Examples: humans, plants, thermostats.

Weak vs Strong Agency

The listed criteria are all behavioural.

They contain no stipulation that candidate systems possess mental states, such as intentions, desires, or subjectivity.

Behavioural definitions like this are said to define *weak agency*.

When a definition stipulates the possession of mental states (intentions in particular) it is said to define *strong agency*.

Environments

The environment of an object or process is the set of objects or processes that it can causally affect and be affected by.

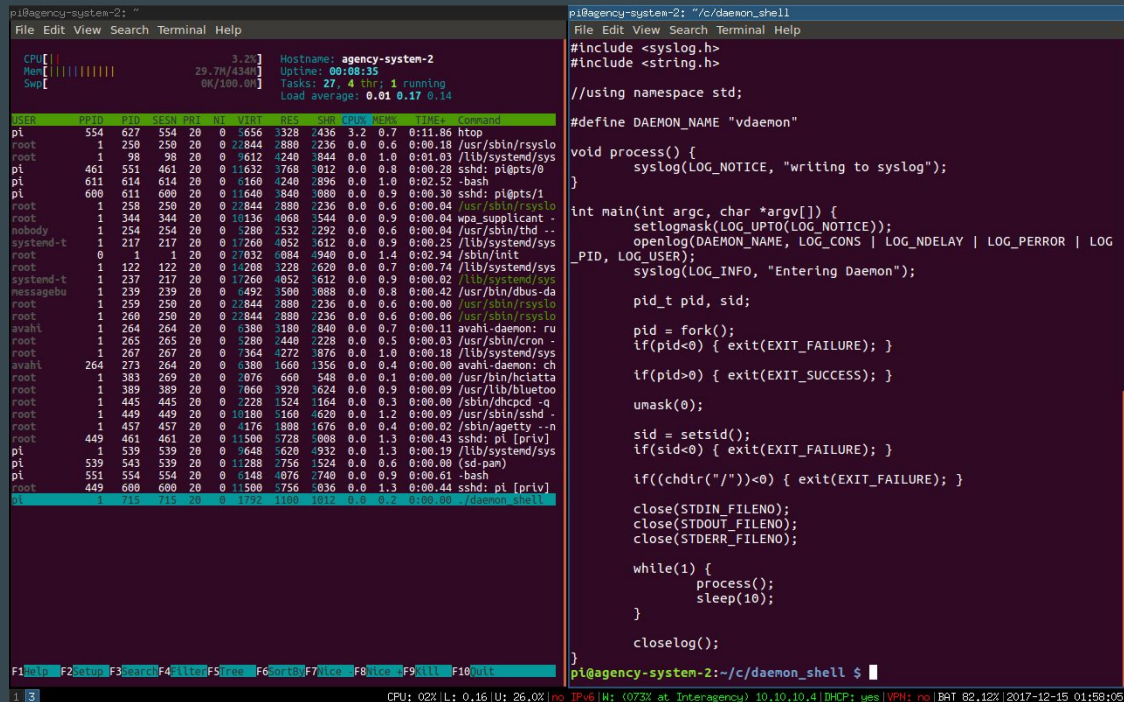
What constitutes the environment of a program?

- Other computational structures (programs, system processes, data, itself, etc)
- Humans (start, terminate, provide input, be affected aesthetically, be affected humorously, etc)
- Physical system it runs on (temperature, weight, intended interaction with electronic components)
- Wider environment (governments, companies, ecosystems, subatomic particles)

Operational Autonomy

Two variants:

- Total causal isolation from human interaction of any kind
- Independence from moment by moment human influence (e.g. program running in a loop waiting for input.)



The image displays two terminal windows side-by-side. The left window shows the output of the 'top' command on a Raspberry Pi, displaying system statistics and a list of running processes. The right window shows the source code for a daemon named 'vdaemon'.

Left Terminal (pi@agency-system-2):

```
File Edit View Search Terminal Help

CPU: 3.2% Hostname: agency-system-2
Mem: 29.7M/434M Uptime: 00:08:35
Swap: 0K/100.0M Ticks: 27, 4 thr: 1 running
Load average: 0.01 0.17 0.14

USER      PID    PPID   PID  SESS PRI  NI  VIRT  RES   SHR  CPU%  MEM%  TIME+  Command
pt        554    627    554   20    0  9656  5328  7436  3.2  0.7  0:11.86  htop
root      1     250    250   20    0  22844  2880  2236  0.0  0.6  0:00.19  /usr/sbin/rsyslo
root      1     98     98   20    0  9612  4240  1844  0.0  1.0  0:01.03  /lib/systemd/sys
pt        461    551    461   20    0  11632  3768  1012  0.0  0.8  0:00.28  sshd: pt@pts/0
pt        611    614    614   20    0  6160  4240  1896  0.0  1.0  0:02.52  -bash
pt        600    611    600   20    0  11640  3840  1000  0.0  0.9  0:00.30  sshd: pt@pts/1
root      1     258    250   20    0  22844  2880  2236  0.0  0.6  0:00.04  /usr/sbin/rsyslo
root      1     344    344   20    0  10136  4068  1544  0.0  0.9  0:00.04  wpa_supplicant -
nobody    1     254    254   20    0  5280  2532  2292  0.0  0.6  0:00.04  /usr/sbin/thd --
systemd-t 1     217    217   20    0  17260  4052  1612  0.0  0.9  0:00.25  /lib/systemd/sys
root      0      1      1     20    0  27032  6084  1940  0.0  1.4  0:02.94  /sbin/init
root      1     122    122   20    0  14208  3228  1620  0.0  0.7  0:00.74  /lib/systemd/sys
systemd-t 1     237    217   20    0  17260  4052  1612  0.0  0.9  0:00.02  /lib/systemd/sys
messagebu 1     239    239   20    0  6492  3500  1088  0.0  0.8  0:00.42  /usr/bin/dbus-da
root      1     239    239   20    0  22844  2880  2236  0.0  0.6  0:00.00  /usr/sbin/rsyslo
root      1     260    250   20    0  22844  2880  2236  0.0  0.6  0:00.06  /usr/sbin/rsyslo
avahi     1     264    264   20    0  6380  3180  1840  0.0  0.7  0:00.11  avahi-daemon: ru
root      1     265    265   20    0  5280  2440  1228  0.0  0.5  0:00.03  /usr/sbin/cron -
root      1     267    267   20    0  7364  4272  1976  0.0  1.0  0:00.19  /lib/systemd/sys
avahi     264    273    264   20    0  6380  1660  1356  0.0  0.4  0:00.00  avahi-daemon: ch
root      1     383    269   20    0  2076  660  548  0.0  0.1  0:00.00  /usr/bin/hciatta
root      1     389    389   20    0  7060  3920  1624  0.0  0.9  0:00.09  /usr/lib/bluetoo
root      1     445    445   20    0  2228  1524  1164  0.0  0.3  0:00.00  /sbin/dhpcd -q
root      1     449    449   20    0  10180  5160  4620  0.0  1.2  0:00.09  /usr/sbin/sshd -
root      1     457    457   20    0  4176  1808  1676  0.0  0.4  0:00.02  /sbin/agetty --n
root      449    461    461   20    0  11500  5728  1008  0.0  1.3  0:00.43  sshd: pt [priv]
pt        7     539    539   20    0  9648  5620  1932  0.0  1.3  0:00.19  /lib/systemd/sys
pt        539    543    539   20    0  11208  2756  1524  0.0  0.6  0:00.00  (sd-pam)
pt        551    554    554   20    0  6148  4076  1740  0.0  0.9  0:00.61  -bash
root      449    600    600   20    0  11500  5756  1036  0.0  1.3  0:00.44  sshd: pt [priv]
pt        1     715    715   20    0  1792  1100  1012  0.0  0.2  0:00.00  /daemon_shell

F1 Help F2 Setup F3 Save F4 Load F5 Free F6 Sort F7 Filter F8 Icon F9 Kill F10 Quit
```

Right Terminal (pi@agency-system-2):

```
File Edit View Search Terminal Help

pi@agency-system-2: ~/c/daemon_shell

#include <syslog.h>
#include <string.h>

//using namespace std;

#define DAEMON_NAME "vdaemon"

void process() {
    syslog(LOG_NOTICE, "writing to syslog");
}

int main(int argc, char *argv[]) {
    setlogmask(LOG_UPTO(LOG_NOTICE));
    openlog(DAEMON_NAME, LOG_CONS | LOG_NDELAY | LOG_PERROR | LOG
_PID, LOG_USER);
    syslog(LOG_INFO, "Entering Daemon");

    pid_t pid, sid;

    pid = fork();
    if(pid<0) { exit(EXIT_FAILURE); }

    if(pid==0) { exit(EXIT_SUCCESS); }

    unmask(0);

    sid = setsid();
    if(sid<0) { exit(EXIT_FAILURE); }

    if((chdir("/")<0) { exit(EXIT_FAILURE); }

    close(STDIN_FILENO);
    close(STDOUT_FILENO);
    close(STDERR_FILENO);

    while(1) {
        process();
        sleep(10);
    }

    closelog();
}

pi@agency-system-2:~/c/daemon_shell $
```

Bottom Status Bar:

```
CPU: 02% | L: 0.16 | U: 26.0% | no IPv6 | IN: 073% at Interagency 10.10.10.4 | DHCP: yes | VPN: no | BAT 82.12% | 2017-12-15 01:58:05
```

Sensing

A script senses by being affected by the environment.

- A script reads the system status from the OS.
- Fatal sensing: something in the environment causes a script to terminate (a human, another program, itself, a lightning strike)

```
pi@agency-system-2: ~/modeling-agency/modeling-agency
File Edit View Search Terminal Help
cat /etc/*release >> mySystem.txt;
echo "" >> mySystem.txt;
pi@agency-system-2:~/modeling-agency/modeling-agency $ cat mySystem.txt

HARDWARE

Architecture:           armv6l
Byte Order:             Little Endian
CPU(s):                 1
On-line CPU(s) list:    0
Thread(s) per core:    1
Core(s) per socket:    1
Socket(s):              1
Model:                  7
Model name:             ARMv6-compatible processor rev 7 (v6l)
CPU max MHz:            1000.0000
CPU min MHz:            700.0000
BogoMIPS:               697.95
Flags:                  half thumb fastmult vfp edsp java tls

HARD DISK PARTITIONING

NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
mmcblk0     179:0    0  14.9G  0 disk
└─mmcblk0p1 179:1    0   41.8M  0 part /boot
└─mmcblk0p2 179:2    0   14.8G  0 part /

OPERATING SYSTEM

Linux agency-system-2 4.9.41+ #1023 Tue Aug 8 15:47:12 BST 2017 armv6l GNU/Linux
PRETTY_NAME="Raspbian GNU/Linux 9 (stretch)"
NAME="Raspbian GNU/Linux"
VERSION_ID="9"
VERSION="9 (stretch)"
ID=raspbian
ID_LIKE=debian
HOME_URL="http://www.raspbian.org/"
SUPPORT_URL="http://www.raspbian.org/RaspbianForums"
BUG_REPORT_URL="http://www.raspbian.org/RaspbianBugs"

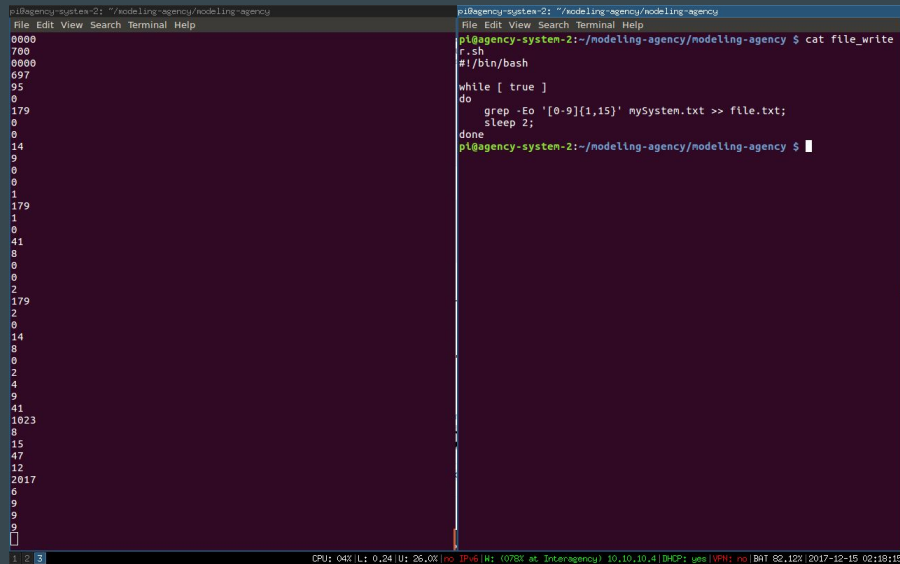
pi@agency-system-2:~/modeling-agency/modeling-agency $
pi@agency-system-2:~/modeling-agency/modeling-agency $ sh ./system_info_writer.sh

0,20 | U: 26,0% | no IPv6 | W: <076% at Interagency> 10,10,10,4 | DHCP: yes | VPN: no | BAT 82,12% | 2017-12-15 02:09:10
```

Acting

A script acts by affecting its environment.

- A script appends / removes text from a file
- A script terminates another script
- Networked scripts buy and sell government bonds



```
pi@agency-system-2: ~/modeling-agency/modeling-agency
File Edit View Search Terminal Help
0000
760
0000
0000
097
95
0
179
0
0
14
9
0
0
1
179
1
0
41
8
0
0
2
179
2
0
14
8
0
2
4
9
41
1023
8
15
47
12
2017
6
9
9
9

```

```
pi@agency-system-2: ~/modeling-agency/modeling-agency
File Edit View Search Terminal Help
pi@agency-system-2:~/modeling-agency/modeling-agency $ cat file_write
r.sh
#!/bin/bash
while [ true ]
do
    grep -Eo '[0-9]{1,15}' mySystem.txt >> file.txt;
    sleep 2;
done
pi@agency-system-2:~/modeling-agency/modeling-agency $
```

CPU: 04% L: 0.24 U: 26.0% no IPv6 W: (078% at Interagency) 10.10.10.41 DHCP: yes VFN: no BAT 82.12% 2017-12-15 02:18:15

Software Thermostat

A script that:

1. monitors the temperature of the CPU
2. when the temperature falls below a certain value, it begins to raise it
3. when the temperature rises above a different value, it stops raising it

```

pi@raspberrypi: ~
File Edit View Search Terminal Help

CPU: 100.0%
Mem: 100.0%
Tasks: 42, 10 thr; 3 running
Load average: 1.60 1.10 0.50
up 5m 30s
0% 100%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

```

PID	PPID	UID	GID	VSZ	PMEM	USER	COMMAND
1	root	0	0	21884	1188	4968	5.0 0.1 0.0:07.67 /sbin/init
555	pl	0	0	1852	532	4280	0.0 0.2 1.2:00.20 /lib/systemd/systemd --user
559	pl	0	0	1372	872	3584	0.0 0.5 0:00.00 (-sd-pam)
546	root	0	0	1872	932	476	0.0 0.7 0:00.19 /bin/login -f
582	pl	0	0	1522	168	828	5.0 0.0 0:00.62 -bash
537	root	0	0	1684	932	856	0.0 0.2 0:00.06 /usr/sbin/mnissd -t 0.0 0.0
533	root	0	0	1932	784	384	0.0 0.4 0:00.11 /sbin/dmccp -s -d
480	root	0	0	1692	536	504	0.0 1.1 0:00.26 /sbin/wpa_supplicant -u -s -0 /run
440	root	0	0	1184	260	176	0.0 1.2 0:00.10 /usr/sbin/sshd -
3420	root	0	0	1504	680	960	5.0 0.2 0:00.44 -sshd: pt@pts/0
3681	pl	0	0	1000	420	1028	3.5 0.8 1:23.71 -sshd: pt@pts/3
3684	pl	0	0	1164	424	882	5.0 0.1 0:02.39 -bash
4309	pl	0	0	660	472	728	3.7 0.6 0:02.90 -sshd: pt tree /
1504	root	0	0	1504	760	876	0.0 1.2 0:00.41 -sshd: pt [priv]
1558	pl	0	0	11504	756	1012	5.0 0.0 0:08.31 -sshd: pt@pts/2
1561	pl	0	0	1152	180	488	0.0 0.9 0:00.64 -bash
1571	pl	0	0	1760	340	436	2.5 0.8 0:02.69 -htop
3258	root	0	0	1504	1720	496	5.0 1.3 0:00.43 -sshd: pl [priv]
3400	pl	0	0	1504	888	540	0.0 0.9 0:00.20 -sshd: pt@pts/1
3272	pl	0	0	1164	424	882	5.0 0.1 0:00.93 -bash
3590	pl	0	0	884	124	104	0.0 0.3 0:00.01 -sh temp_display.sh
3500	pl	0	0	480	476	396	5.0 0.0 0:00.81 -tail -f sys_temp.tx
1171	root	0	0	11504	1724	800	5.0 1.3 0:00.45 -sshd: pl [priv]
1182	pl	0	0	11640	756	992	5.0 0.0 0:02.16 -sshd: pt@pts/0
1185	pl	0	0	1164	260	908	5.0 0.1 0:06.91 -bash
419	root	0	0	260	112	192	5.0 0.9 0:00.10 /usr/lib/bluetooth/bluetoothd
408	root	0	0	3120	194	164	5.0 0.5 0:00.16 wpa_supplicant -B -C/etc/wpa_supp
398	root	0	0	1080	668	552	0.0 0.2 0:00.00 /usr/bin/hotattach -d/serial.b
397	root	0	0	1080	668	552	0.0 0.2 0:00.00 /usr/lib/polkit/polkitd --no-
386	root	0	0	16608	752	1440	5.0 1.3 0:03.07 -usr/lib/polkit/polkitd
383	root	0	0	16608	752	1440	5.0 1.3 0:00.00 -usr/lib/polkit/polkitd
284	avahi	0	0	784	572	328	0.0 0.5 0:00.10 /usr/lib/avahi-daemon/avahi-daemon
288	avahi	0	0	384	184	840	5.0 0.7 0:00.22 avahi-daemon: running [raspberrypi
286	avahi	0	0	384	184	840	5.0 0.7 0:00.00 avahi-daemon: chroot helper
279	root	0	0	59828	688	636	5.0 1.7 0:00.36 /usr/sbin/ModemManager
304	root	0	0	59828	688	636	5.0 1.7 0:00.05 /usr/sbin/ModemManager
260	root	0	0	824	688	364	5.0 1.7 0:00.40 /usr/sbin/cron -f
269	root	0	0	284	476	364	5.0 0.6 0:00.05 /usr/sbin/cron -f
265	root	0	0	1616	1328	1620	5.0 3.2 0:01.51 /usr/sbin/NetworkManager --no-daem
331	root	0	0	1616	1332	1620	5.0 3.2 0:00.22 /usr/sbin/NetworkManager --no-d
323	root	0	0	8164	1352	1620	5.0 3.2 0:00.10 /usr/lib/systemd
280	root	0	0	1840	908	1120	0.0 0.7 0:00.32 /usr/lib/systemd
285	root	0	0	2848</			

Mutual Heat Regulation

Two scripts running on separate devices, regulating each other's temperature.

[illegible]

From Weak to Strong Agency

The system described above has all the ingredients: not only are they systems which sense and perform goal-oriented actions, their interests are entwined with each others.

Yet there is no temptation to describe these scripts as possessing intentions. The notion of ‘agency’ here is for our benefit, a tool we use to construct and understand them.

If they are currently just agents *for us*, how might they become agents *for each other*?

Under what conditions might they need to treat one another as systems with goals, purposes, or interests?

Artifact : Multi-agenda ecosystem

The need for agents to treat each other as agents will arise only when they need to understand and predict each other's behavior.

This will be the case in populations or ecosystems of agents where there are multiple interests, some of which are in conflict.

It will then in the interest of agents to make judgements about the preferences and intentions of the other entities in their environment.

Conclusions

We have considered the notion of agency as a tool for exploring the way that software systems interact with us, with each other, and the wider world.

We have tried to remove the human from these considerations, by asking how the agency these systems exhibit might be made independent of our attributions of agency.

The strategy has been to imagine an ecosystem where those attributions are sustained by the programs themselves.

A final question: is there anything more to human agency than the attributions we give to each other? If not, then what reason is there to deny this status to nonhuman systems?

