Artificial Life Lecture 11

Projects take the form of a mini-research project – though it is *not* expected to be original ground-breaking research

Indeed, taking a pre-existing piece of work and replicating it is a very good idea – because this limits the chance that you are attempting the impossible.

Project Proposals

Project Proposals

Document available on
http://www.cogs.susx.ac.uk/users/inmanh/easy/alife10/proj.html
gives a vast range of possible ideas for your projects, plus some guidelines.

Initial Project Proposal needed from each of you, **hardcopy,** about 600-1000 words (1 or 2 pages), by Lecture of Mon Nov 22nd, wk 8 -- to allow time for feedback.
Seminars week 9: each give a mini-proposal-presentation.

Guidelines for robotic projects

Working with real robots is very hard - maintenance. Probably only feasible for main summer project.

When using simulations be aware of the shortcomings of naive, unvalidated simulations

Worry about Grid worlds, Magic sensors ... ...

There are now simulations, here and elsewhere (eg Khepsim) that have been validated under some limited circumstances - through downloading/testing some control systems on real robot.

Agent projects

Useful robotics projects can be done with such careful simulations.

Then there is still a role for more abstract simulations for tackling (eg) problems in theoretical biology
-- but then these are not robotics simulations

Many useful Alife projects are of this latter kind – but then it is almost certainly misleading to call these 'robotics'.

'AGENTS' is a more general term to use here.

Advice on project choice

- Choose any area that interests you (check with me if not sure) where Artificial Life techniques are relevant
- **BUT THEN** pick the **SIMPLEST POSSIBLE** starting place for your project
- The mistake 80% of people make is **OVER-AMBITION!!!!**
- A large part of what you should be worrying about is not "doing the project" – it is "picking a do-able project" given the time constraints.
- Hence the advice to start by replicating an existing *simple* piece of work, before trying to extend/change it

What you should **NOT** be doing !

Please do **not** think of this as "doing a project in Artificial Life – whatever that is"

Think of it as doing a *scientific*, or an *engineering*, or an *entertainment* or *educational* project … …

… … using Alife methods

What you *should* be doing

There should be a clear, well-defined aim for the project, that can be stated in one short sentence.

The slogan for the T-shirt of the film of the book…

"I demonstrated that X…"

This then provides a yardstick, by which the reader (examiner!) can judge success or failure.

Objective test, not just vague intentions: eg if money was bet 'on success' – how would you unambiguously decide win or loss?

Possible aims -- scientific

Can be **scientific**: "My hypothesis is that X under circumstances Y – and I shall test the hypothesis"

Eg "… that coevolution leads to ever-increasing fitness under circumstances …"

Then the reader can judge whether you chose a suitable model, and took proper care

…or engineering

"I have a reasonable way of solving **this** kind of problem"

The reader will be interested in seeing how it compares for efficiency or speed with other methods.

A GA that is slower than random search is not very impressive.

… or entertainment or educational

"This will help you enjoy yourself, or instruct yourself"

Then the reader will want to assess whether it does indeed achieve the goals

So before you get lost in programming …

Stand back, and work out what you want to achieve !

The program is just one (important) part of the whole project.

Before looking at programming, let's look at the structure of the write-up into which it will fit.

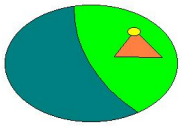
Write-up starts with…

1. A title
2. A short abstract is desirable (essential for major project)
3. An introductory section explaining the context of the issue you are investigating, and your aims

It is **essential** that the casual reader who just reads the intro should come away with a broad picture of your project (cf mini-presentation at seminars)

Where you are heading

OK, so the intro describes the territory, and your goal.



The second section should describe the known part of the territory – existing work in this area, a literature review.

How will you travel there ?

OK, so now the reader (and hopefully the writer!) knows

(a) What you are heading for, in what territory

(b) And where you are starting from.

Now you have to plan the journey, section 3.

Section 3

This gives an overview of how you aim to achieve your goals:

"I am going to model P, Q and R, ignoring S T and U. I will have to build these different sections into my code, and run a series of experiments."

You must convince the reader (and yourself) that you are making sensible choices.

Reports on program and experiments

- The next sections should report on the specific problems you had to tackle in writing your program (at a high level).
- Sufficient detail of the implementation for someone to be able to work out what you did
- Tests and checks to see if it did what you intended.
- Reports of experiments (probably many runs, keeping statistics of means and standard deviations)

Discussion and Conclusions

A self-critical look at what you have achieved, and what you failed to achieve – do your claims stand up to rigorous scrutiny ??? *(..do you understand scientific method?)*

"To what extent did you reach your goal?"

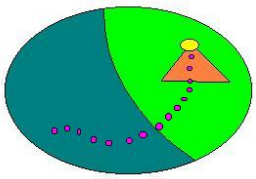
Then a bibliography, properly referenced.

And an Appendix with all your code, properly presented and commented.

N.B. remember to spell-check and proof-read!

Stepping Stones

In planning the journey, **PLEASE please PLEASE please** think in terms of tiny stepping stones, where the first one is **very simple !!**



And make this **literally** the first step of your project.

Over-ambition

Having looked through many project proposals over years, I would say 80% are unrealistically over-ambitious in terms of what is achievable in the timescale – *even after getting this warning!*

This Alife project is an opportunity to realise just how much (… or how little) can be achieved in so many weeks. Make your strategic/pragmatic mistakes here, before coming to bigger summer project.

Over-ambition is OK provided…

It is essential that the long-term goals of a project, the motivation, is indeed big and important …

… provided that it is tempered with realism – and this is where the stepping-stone approach is **crucial.**

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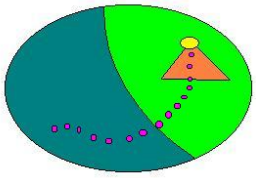

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To give an example

If my project was to use artificial evolution to evolve Dynamic Recurrent Neural Nets as controllers for robots to do cooperative behaviour in groups, what would my first stepping stone be ?

1. I would start with a single robot, not several
2. I would start with simplest feedforward NNs
3. I would start with hand-coding, not evolution

Simplicity

I would start with an empty environment into which 1 robot is placed -- then I would handcode the control system (as a simple Braitenberg vehicle) and check that I can get it to move forwards

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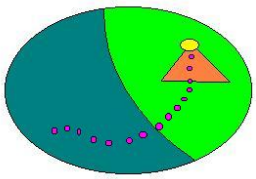

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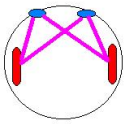
Second step ?

Then I might try setting up a simple Braitenberg vehicle with just 4 possible wires between eyes and motors



And write a simple genetic algorithm to evolve the 4 possible weights on these wires, to produce phototaxis

Re-assess

Once I had achieved this, I would re-assess how much time is left before the deadline, and take a more realistic view of what is achievable in the time available

-- how can I review my possible next stepping stones, so as to take me towards my over-ambitious goal?

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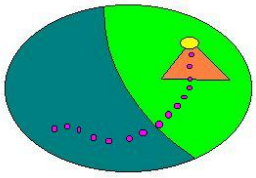

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Adjusting one's goal

This may well result in revising one's goals, with the benefit of hindsight – this is quite usual in research.

BUT this does not excuse wandering about aimlessly, without any clear view of what the goals (currently) are.

Without any clear goals, there are no criteria to judge whether the work is good – and usually it will be self-indulgence rather than research!

Software Engineering principles

1. Analysis -- including 'acceptance criteria'
2. Design – first high-level, then low-level
3. Implementation – coding and testing
4. Quality Assurance – including understandable documentation

Statistics

If you are trying to prove that your personal method of tackling a problem is (a) superb or (b) at least as good as other methods –

-- then you have to do a fair comparison, including with mindless methods such as random search

And you should do multiple runs (say at least 10, tho preferably 100s) and report average results and standard deviations

References, using other work, plagiarism

Using other people's ideas, even their program code, is absolutely fine **provided** that this is properly acknowledged.

General Professional standards will be expected

(1) in matters of punctuation, vocabulary choice, standard English grammar, and the conventions of academic discourse (including reference to sources).

(2) in presentation of code (for programming projects): Codes for Programming Projects should be submitted as an appendix to the main report.

(3) in formal aspects of presentation (that is word-processing/typing, printing).

Plagiarising yourself!

Sometimes people want to develop work they did on one course for another course next term, or for their main summer project.

This is fine, **provided** that you then cite very clearly in your write-up which work of yours was done for a previous course – 'cite yourself' with the same rigour that you must cite other people.

(Obvious university rules about not getting credit for the same piece of work on 2 different courses)

Start small

Rather than starting with a big version of a problem, and an evolutionary run that takes 3 weeks without success before you decide that something is wrong --

-- start with a much smaller version, so as to debug things.

Eg with Hillis-style sorting networks, start with something that sorts lists of size 4 or 8, not 16!

Did I say this before ??

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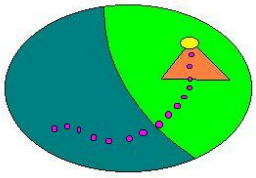

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The Classic Mistakes

"Let's make some Alife simulation with lots of little creatures running around and …um… chasing each other … or…um… doing interesting things … or …"

No motivation for the work

"I haven't got any experience at doing a project, but I reckon I can take a 3-year PhD size topic and do it in a week over Christmas"

No sense of realism

Project Proposal – by Monday 22 Nov

1. State your hypothesis (if scientific project) or end goal (if engineering), or …
2. What will be the criteria for success?
3. Give a rough overview of the methods you will use
4. Explain why these are reasonable methods for your aims
5. Cite 3 references from the existing literature that you will be using to guide your work