Case-Based Learning vs. other learning methods

- Explanation-based learning and inductive learning both use the paradigm of concept learning - answer the question “when is the current situation an example of some concept”

- Case-based learning can be used for this (interpretive Case-based learning)

- Case-based learning can also be used as part of a Case-based planning system (problem-solving Case-based learning)

- Explanation-based learning and Inductive learning reduce experience to something like a set of rules

- Case-based learning retains the information from earlier experience for direct use.

- EBL and induction have particular algorithms; CBL is an approach; there is no dominant algorithm.
Case-Based reasoning: Example

• Case-based learning is used in the context of case-based reasoning

A host is planning a meal for a set of people who include several people who eat no meat or poultry, one of whom is allergic to milk, several “meat and potatoes” men, and her friend Anne. It is tomato season, so she wants to use tomatoes. She remembers the following:
I once served tomato tart (made from mozzarella cheese, tomatoes, dijon mustard, basil, and pepper, all in a pie crust) as the main dish during the summer when I had vegetarians come for dinner. It was delicious and easy to make. But I can’t serve that to Elana (the one allergic to milk).

I have adapted recipes for Elana before by substituting tofu products for cheese. I could do that, but I don’t know how good the tomato tart would taste that way.
She discards the idea of the tart, and continues. Since it is summer, she decides to consider grilled fish. But she remembers:

I once tried to serve grilled fish to Anne, but she wouldn’t eat it. I had to put hot dogs on the grill at the last minute.

I once saw Anne eat mahi-mahi in a restaurant. What kind of fish does Anne eat? The fish she did not eat was whole with the head; the fish she ate looked like a steak. How about swordfish?
Case-based reasoning in menu planning

- Basic idea: recall similar cases from the past, and apply them to the present situation.

- Cases are used to suggest how to solve a new problem (eg, suggest main dish)

- Cases are used to adapt a solution (eg tofu for cheese)

- Warn of failure (eg Anne doesn’t eat fish)

- Interpret a situation (eg what kind of fish does Anne eat?)
Case-based reasoning in real life

- Lawyers are trained this way - legal system is based on cases
- Doctors often argue this way
- Car mechanics discuss their experiences
- Day-to-day non-expert reasoning (like the meal planning)
Basics of case-based reasoning

• In the context of Case-based reasoning, Case-based learning is simply a matter of storing new cases.
Case-based Design

- Design problem - put together known things in a new configuration to satisfy a goal

- Underconstrained design problems: many solutions will do, but the space is very large

- Meal planning is like this; endless possibilities of food that one could prepare; only some of them go together. Old case can provide large parts of a solution

- example: a meal for a large group - lasagne. This time there are vegetarians in the group. Make a small change to vegetarian lasagne. The rest of the menu can stay the same, and satisfies other menu constraints (easy to prepare in quantity, hearty, etc.)
A CBR success — CLAVIER

- Lockheed has a problem of laying out composite materials in an oven

- Nobody quite knows why some configurations work and others don’t (where in the oven the are, how even the heat is, how pieces shield one another, etc.)

- However, there are a lot of notes of things that worked and things that didn’t

- Case-based reasoning is used to determine how to do this in a new case

- Learning happens when a new case has to use the old cases in novel ways; maybe it works, maybe it doesn’t. The result is a new case.
CBR and planning

- Planning the problem of composing lots of actions together for a goal

- Often the operations interact; example is “tower of hanoi” problem

- Never place a disk on a smaller one, but move the stack from one peg to another.

- Cooking is an example:
  - de-bone the chicken
  - Start the noodles 10 minutes before serving time
  - Put the snow peas in at the end

- Cases can include a lot of this detail information
Case-based reasoning and Explanation

- Problem is to take something that has happened, and explain why

- We have seen how to use logic for this; it requires a background theory and reasoning to support it.

- Case-based reasoning requires a set of cases

- Example: Swale was a racehorse who died suddenly in the prime of life. Why?

- Remember similar case: Janice Joplin died in the prime of her career. Did Swale use illegal drugs?

- Jim Fixx died after a run from an unknown heart condition. Did Swale just go for a run? Did he have a heart condition?
Requirements for case-based indexing

- How can we find a relevant case? In some cases, the similarities are superficial (tomatoes)

- In other cases, the similarities are deeper (Swale and Jim Fixx). How do we index these to find the really relevant cases?

- The answer to these questions must be considered when storing a new case - how do we index it? What is important to remember about it?

- Adaptation - how can we make the changes to a case to fit the new case?

- Evaluation - how can we tell that a new case is really a satisfactory solution?
  - This could be a recursive application of Case Based Reasoning.