计算思维

课程六

Perceptron

Hidden Layers · Output Layer

Input · First Layer · Second Layer · Third Layer

$$a^1 = f^1(W^1p + b^1)$$

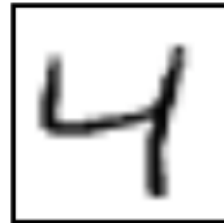$$a^2 = f^2(W^2a^1 + b^2)$$

$$a^3 = f^3(W^3a^2 + b^3)$$

$$a^3 = f^3(W^3f^2(W^2f^1(W^1p + b^1) + b^2) + b^3)$$

Hamming Network

Feedforward Layer

Recurrent Layer

$$\mathbf{a}^1 = \mathbf{purelin}\,(\mathbf{W}^1\mathbf{p} + \mathbf{b}^1)$$

$$\mathbf{a}^2(0) = \mathbf{a}^1 \qquad \mathbf{a}^2(t+1) = \mathbf{poslin}\,(\mathbf{W}^2\mathbf{a}^2(t))$$

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MNIST Data Set

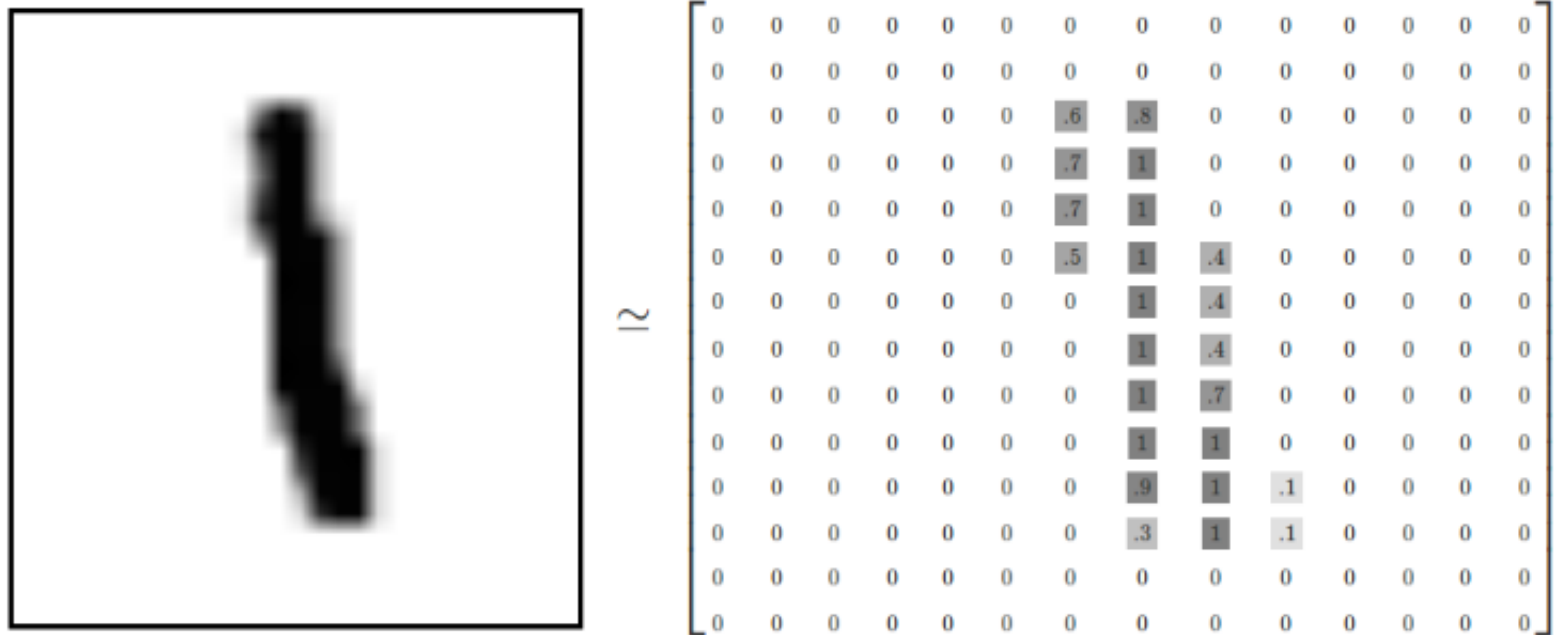| Data X	
Label Y	5 0 4 1
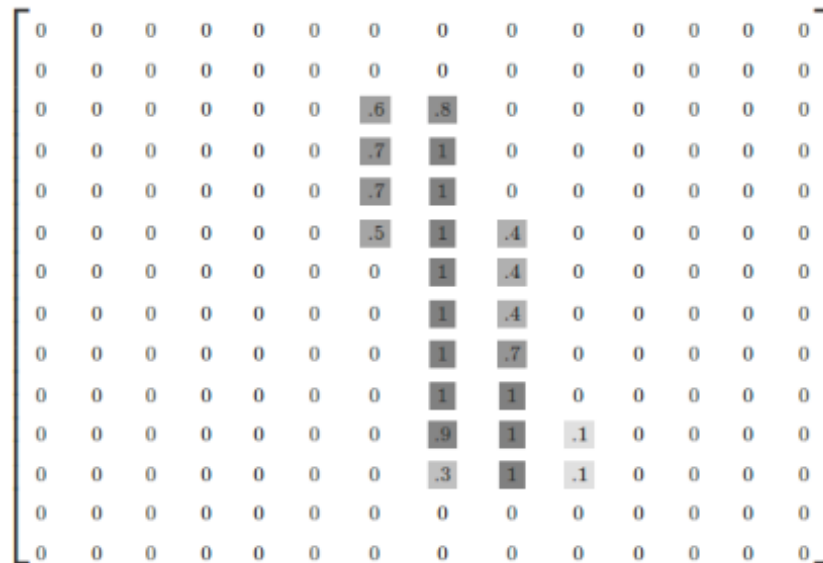
Represent a Picture: 28*28 matrix

28*28 pixels: each is within [0,1]

Represent a Picture: 784*1 vector

Represent a Label: 10*1 vector

$$\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$ 10*1

Each element represents a class

The Goal of Learning

Handwriting Recognition

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Classification

$$X \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0.6 \\ 0.8 \\ 0 \\ 1 \\ 1 \\ ... \\ 0 \\ 0 \end{bmatrix} \quad 784*1$$

$$Y \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \quad 10*1$$

Learning

$$X \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0.6 \\ 0.8 \\ 0 \\ 1 \\ 1 \\ ... \\ 0 \\ 0 \end{bmatrix}$$ **784*1**

Model?
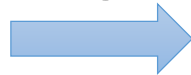
Classification

$$\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} Y$$ **10*1**
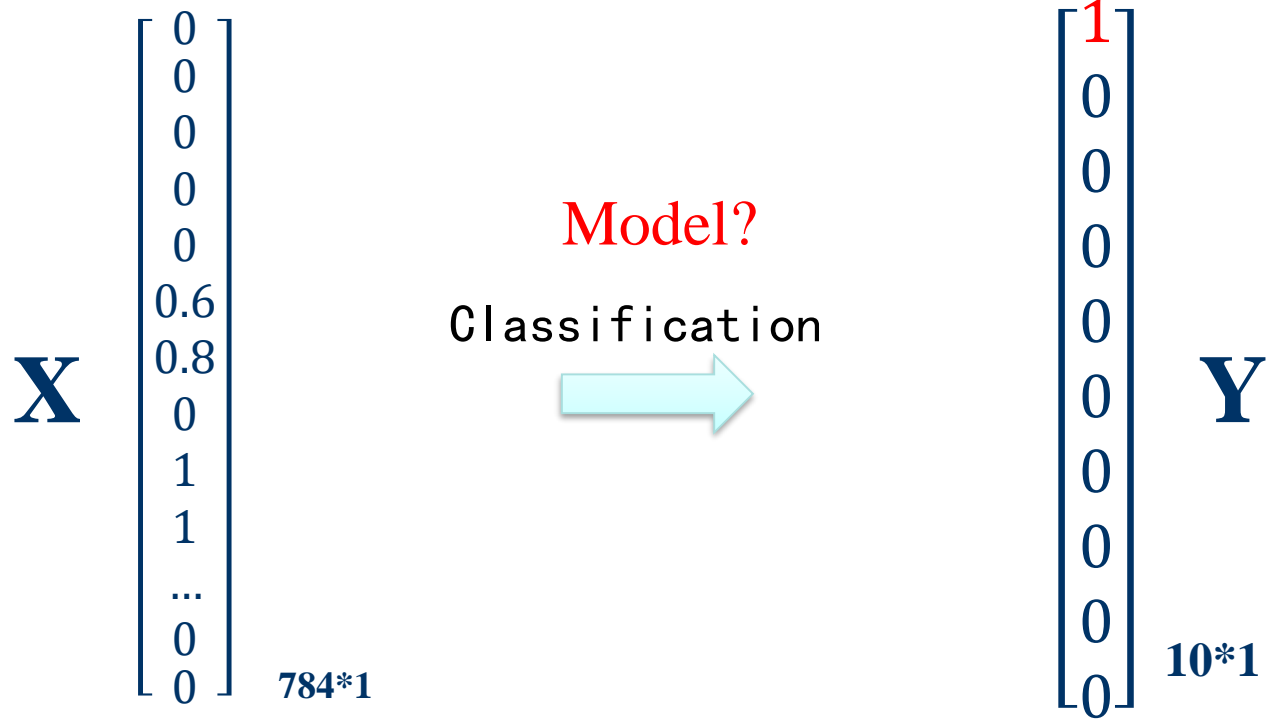
Attitude Control
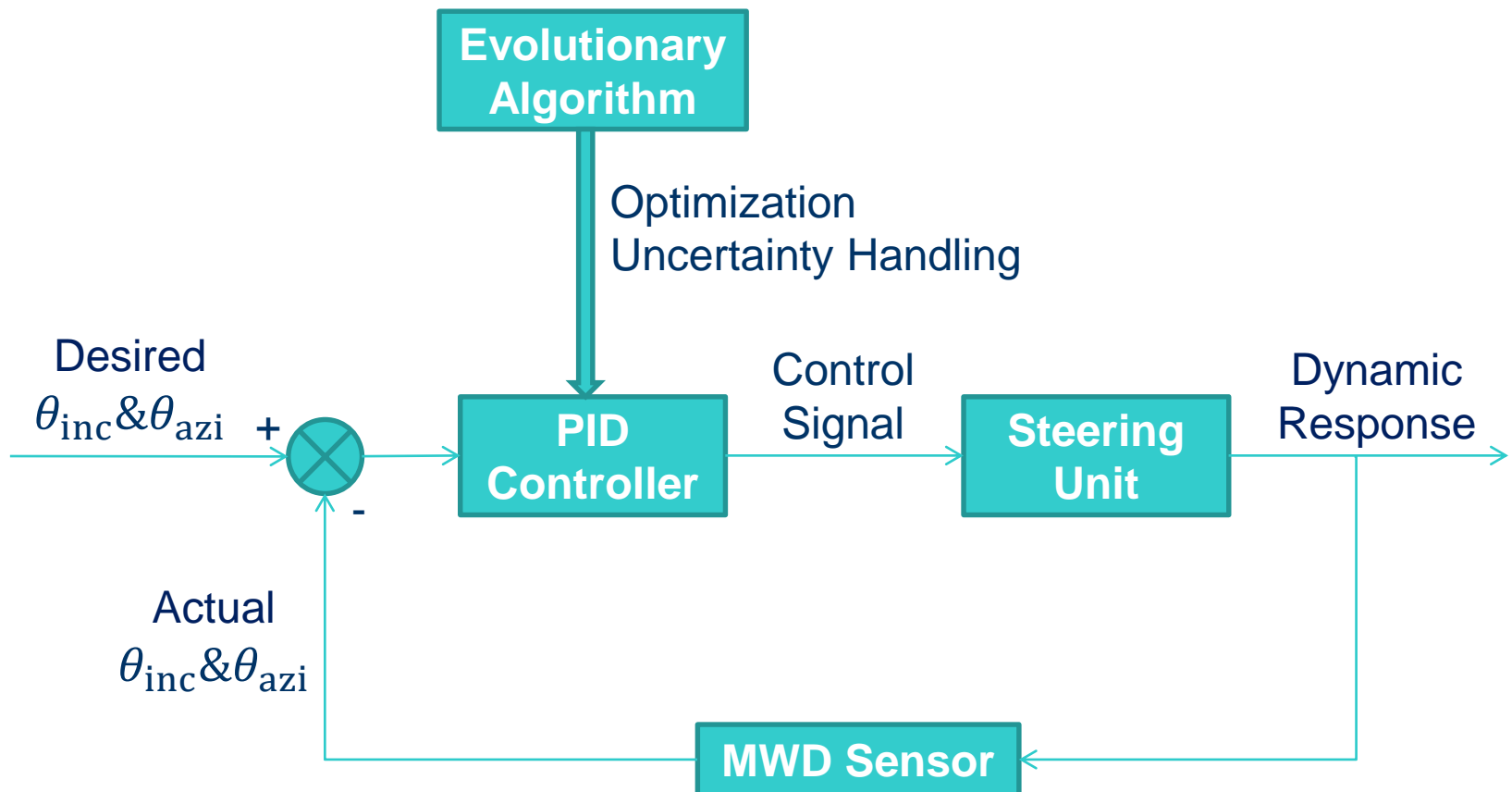
Structure

Evolutionary Algorithm (EA)

START

↓

Initialization

↓

Fitness Assignment

↓

Selection

↓

Crossover&Mutation

↓

Replacement

↓

Stop? — **No**

YES

↓

END

PID Controller

P: $K_p e(t)$

Setpoint → e

I: $K_i \int_0^t e(t)$

D: $K_d \frac{de(t)}{dt}$

+ / -

Output ← Plant
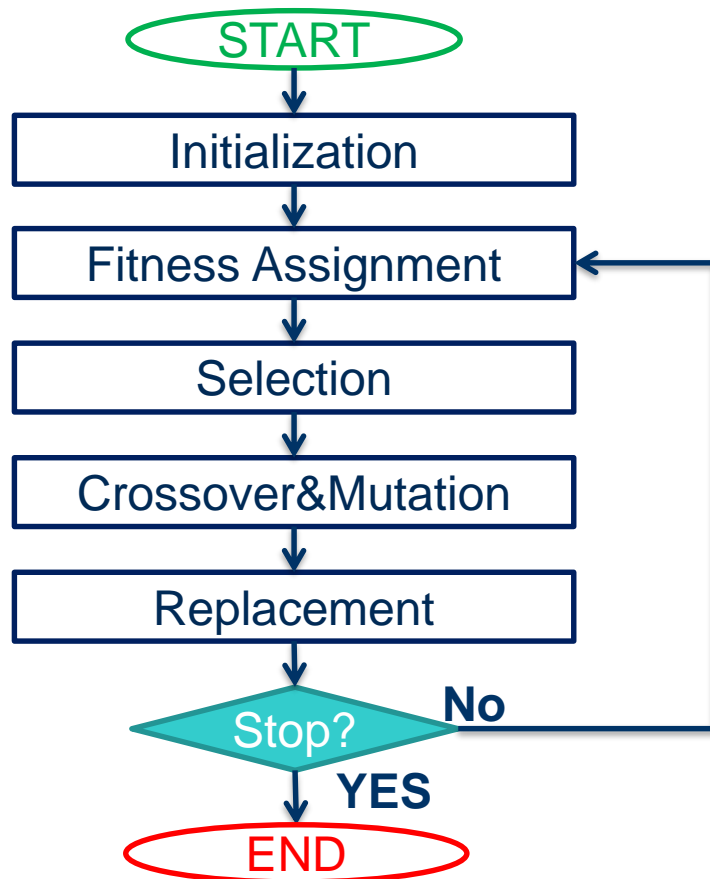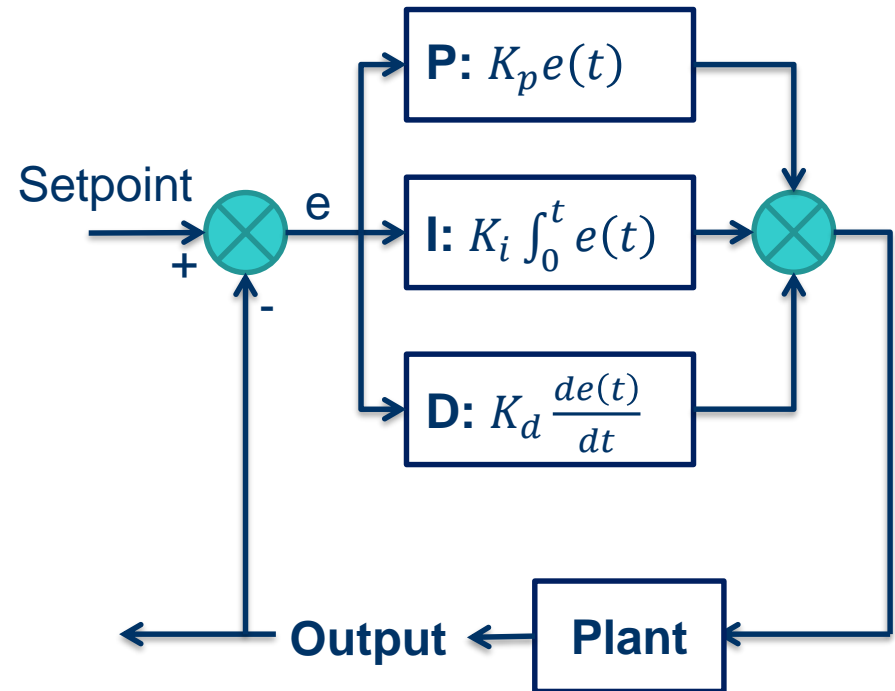
Controller: $C = \dfrac{K_D s^2 + K_P s + K_I}{s}$

Optimization of Controller
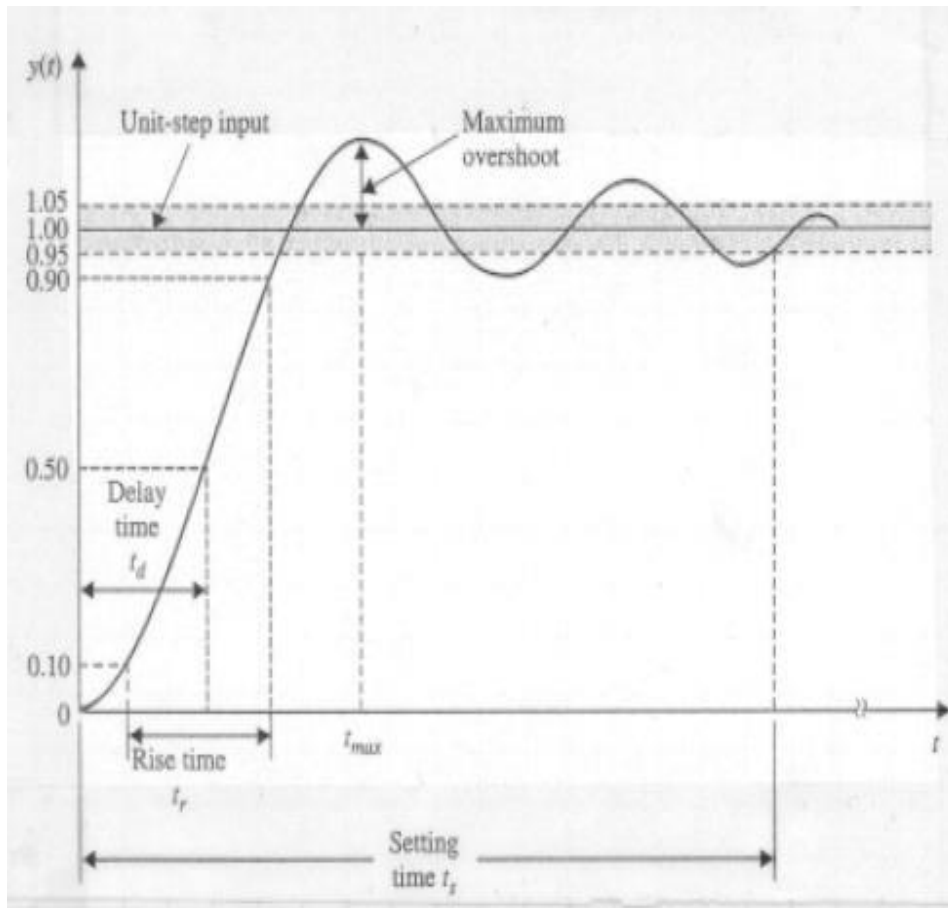
Unit Step Response

Multiobjective Optimization Using Evolutionary Algorithm

1) Objectives:
● Min. Steady-State Error
● Min. Settling Time

2) Constraints:
● Maximum overshoot < 5%
● System is always stable

3) Decision variables:
● K_P, K_I, and K_D

4) Closed-loop transfer function:
● $\frac{Y(s)}{U(s)} = tf(K_P, K_I, K_D)$

Presentation and Writing Skills

- **Organizing your presentation**

  1) Outline

  2) Types of organization methods (logical development)

- **Presenting**

  1) Verbal and non-verbal communication

- **How to be an organizer for the conference**

- **Write an Abstract**

Organization

Importance of organization

- The ideas are grouped and ordered in a way that makes the information easy to understand and remember.

- By organizing your ideas you will demonstrate to your audience that you are taking your presentation responsibilities seriously.

- Organization helps you use your limited time more efficiently.

- Organizing your presentation ahead of time will help you feel more comfortable speaking English.

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Using an Outline

Outline: plan and give your presentation

- Do you think that cultures differ in the way they organize material?

- **YES**

- How?

- In some cultures the **main point** does not come until the **end** of the presentation.

- In others it is stated **right at the very beginning**.

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In America

Which one is typical of American culture?

- Stating the main point first

- A common rule that teachers in the United States like to follow when making a presentation is :

- "first tell **what you will say**, then **SAY** it, and then **tell what you have said**".

- This is not the only type of organization, but American people will expect you follow it.

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The easiest way

Simply a list of the main points you will talk about

- **Functions of the machine**

- **Parts of the machine**

  External

  Internal

- **Limitations of the machine**

- **Conclusion**

Types of organizational structure (logical development)

It depends on types of information you are presenting

Analysis

- braking a large subject into smaller parts to help clarify the nature of the parts.

Chronology or sequence

- Time or steps of a process

Problem/solution

- Posing a problem and then explaining how it is solved

Comparison and contrast

- Showing similarities and differences between concepts
- showing merits and demerits of two each

Types of organizational structure (logical development)

Cause and effect

- Focusing on various contributing causes leading up to a particular effect or event, or showing the effects stemming from a particular cause or event

Hypothesis and support

- Presenting a hypothesis and then explaining the evidence that supports it and/or evidence that refutes it

Case study

- Using a particular example to help establish, prove, or disprove a generalization

Profile of Jane Frost

- A Graduate student applying for a TA position

- Expertise in major field

   1) Undergrad degree in the field

   2) Graduate degree with honors

   3) Strong research interest

- Work experience

   1) Peer tutoring, junior year in college

   2) Lab research assistant, one semester

While Presenting

- Be aware of your voice, pace, and tone

- Speak loud enough so that everyone hears you

- Articulate clearly so that everybody understands you.

- Be aware of your tone (don't sound angry or bossy), but sound confident.

- Speaking clearly doesn't mean speaking fast; yet, don't speak too slowly let you put students to sleep.

- Open your mouth for clear articulation, even though this may be impolite in your own culture.

- SPEAK CORRECTLY

While Presenting

- Be aware of your body language (being a teacher and being in a different culture): eye contact

- Organizational cues: certain words or phrases that can signal that the instructor is introducing a new idea, has finished and idea, is giving and example, is concluding, etc.

- Using visuals

How to be an organizer

- Choosing a topic of general interest to all participants

- Creating a 'call for proposals'

- Evaluating abstracts

- Scheduling the presentation and notifying presenters

- Making a room reservations

- Developing a program for the conference

- Assigning facilitators

Form different committees

Call for proposals committee

- Create a 'call for proposals' (conference topic, purpose, who is involved, what fields are involved, location, deadline, contact information, criteria)

- Email and announce the 'call for proposals'.

Abstract evaluation committee

- Collect abstracts, review them, and give detailed feedback (comments on abstracts and accept/rewrite).

Conference organization committee

- Assign one facilitator, schedule the presentation, and create booklet (call for proposals, presenters' abstracts, and programs for the conference)

Write an Abstract (150~250 words)

Background information(present tense)

Principal activity(present perfect tense)

Methodology(present tense)

Result(past tense)

Conclusions(present tense)

Example

Background information

Uncertainty is an important feature abstracted from real-world applications. Multi-objective optimization problems with uncertainty can always be characterized as robust multi-objective optimization problems. Over recent years, multi-objective optimization evolutionary algorithms have demonstrated the success in solving multi-objective optimization problems. However, most of them do not consider disturbance in the design.

Principal activity + Methodology

In order to handling the uncertainty in the optimization problem, we first give a thorough analysis of three important issues on robust optimization. Then, a novel evolutionary algorithm called multi-objective optimization evolutionary algorithm with robustness enhancement is developed, where the seamless integration of robustness and optimality is achieved by a proposed novel archive updating mechanism applied on the evolutionary process as well as the new robust optimal front building strategy designed to construct the final robust optimal front. Furthermore, the new designed archive updating mechanism makes the robust optimization process free of the enormous computational workload induced from sampling.

Result + Conclusion

Experimental results on a set of benchmark functions show the superiority of the proposed design in terms of both solutions' quality under the disturbance and computational efficiency in solving robust multi-objective optimization problems.