Master of Technology in Knowledge Engineering

Unit 7:

Developing Intelligent Systems for Performing Business Analytics
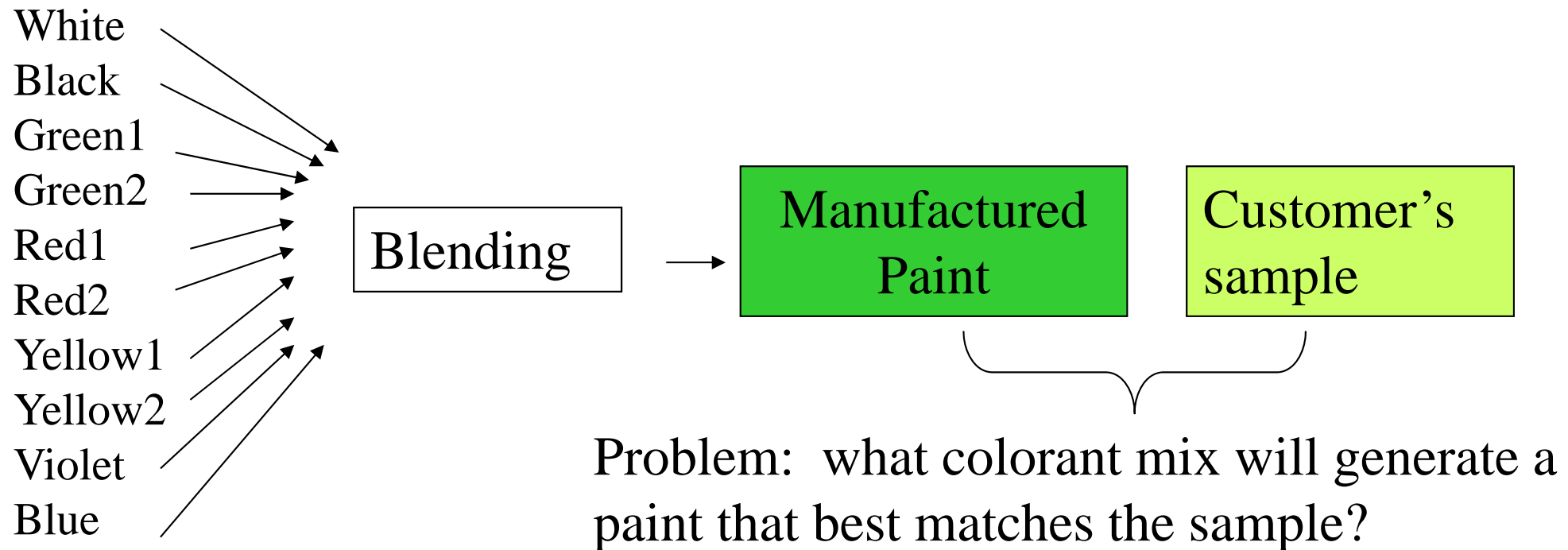
Hybrid Systems: Case Study

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Paint Mixing Application

- A paint manufacturer generates paints to order
- The customer provides a sample of the required color which is then duplicated by mixing up to 10 different colorants

White
Black
Green1
Green2
Red1
Red2
Yellow1
Yellow2
Violet
Blue

→ Blending →

Manufactured Paint

Customer's sample

Problem: what colorant mix will generate a paint that best matches the sample?

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Estimating the Colorants

- Experienced staff can estimate the correct mix of colorants by looking at the sample color. They do the following:

- Step1: assign the sample color to one of 16 color classes using combinations of the 5 colors: red, yellow, green, blue, violet
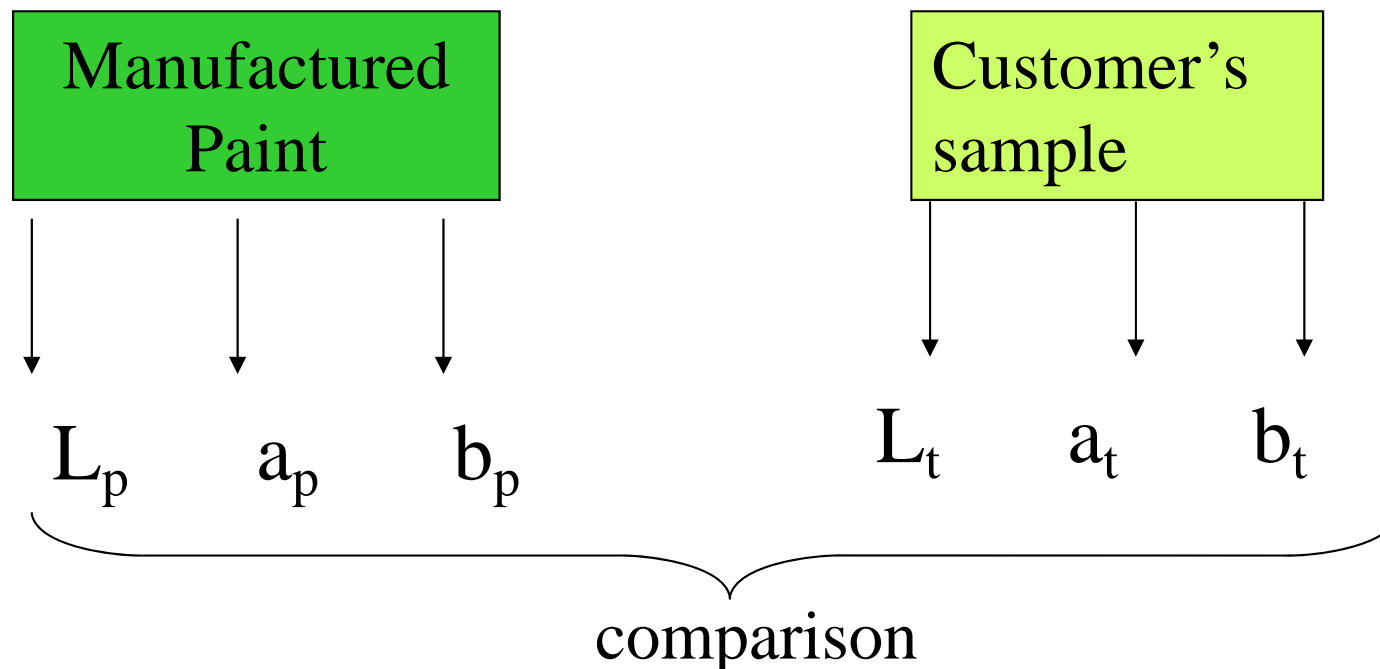
Customer's sample

"This is yellowish green!"

- Step2: estimate the range of colorants that may work for that class, e.g. around 50% green, 30-40% yellow & the rest white

Manufacturing the Paint

- Mix the colorants according to the defined proportions

- Dry and then produce the color paint

- Compare the manufactured paint with the sample. If the color does not match then "redo" the job until a good match is obtained (can be expensive)

Comparing Colors

- The accuracy of the color match is computed by measuring the surface spectral reflection of the sample and the manufactured paint and comparing. Spectral reflectance is measured with 3 parameters

Manufactured Paint			Customer's sample		

L_p a_p b_p L_t a_t b_t

comparison

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Additional Information (Physics)

- The 3 spectral parameters can be used to deduce color
  - Can transform them to lightness, hue, chroma using a known formula
  - There is a loose mapping between hue & chroma and the 5 colors used by the experts as shown loosely below*

Increasing values →

Hue | red   yellow   green   blue   violet

yellow   green

Hue →
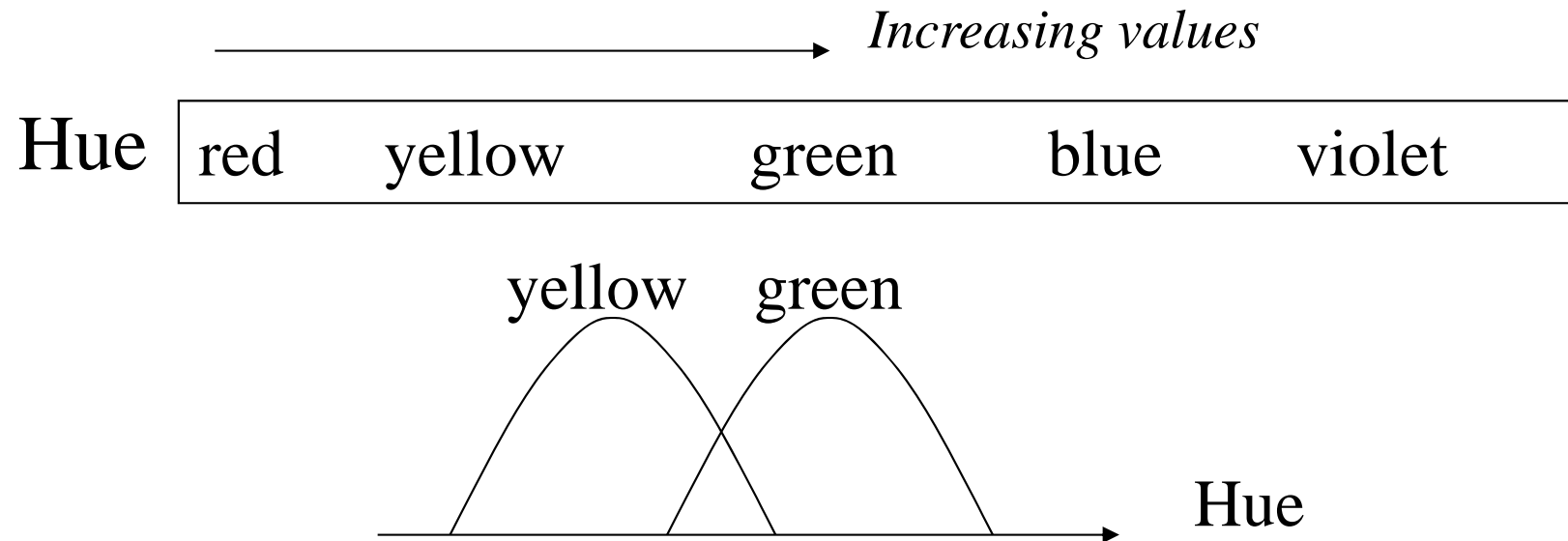
This is only a loose approximation of the actual physics/optics involved

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Objective

- To develop an intelligent system that can predict a good mixture of colorants in advance and can simulate the expected color. Only if the results of the simulation are satisfactory, should the actual production process be initiated.

Exercise

This is a pen & paper exercise!!

- Draw a top-level design for the system
- For each of the main modules, suggest a KE technique that is best suited for developing that module
- For each KE technique, list the key design features
  - For NN: what are the inputs, outputs, what data should be collected to train and test the network?
  - For GA: what is the chromosome structure, fitness function etc?
  - For Fuzzy System: how will the rules be acquired, what are the inputs and outputs?
- What are the issues & problems that may be encountered when building the system?