
Color in Computer Graphics: Tutorial Notes

Organizer Aaron Marcus, Principal
 Aaron Marcus and Associates

Location SIGGRAPH 1988
 Georgia World Congress Center
 Atlanta, Georgia

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COURSE #17

Tutorial Description: Color in Computer Graphics

Version 15 May 1988

Course Chair Aaron Marcus

Course Level Intermediate

The speakers will presume some knowledge of color terminology and also color display and manipulation issues in current computer graphics systems.

Who Should Attend? Programmers and managers should attend this course if they needed to know how human beings see color, what colors to select, how to select them, how to display and communicate color effectively, and how people design with color. Professionals developing user interfaces and presentation systems, including training specialists, technical editors, graphic designers, and human factors specialists would also benefit.

Recommended Background The course assumes attendees have some familiarity with color terminology and with color appearance and interaction issues in current computer graphics systems.

Course Description The tutorial will provide terminology, principles, guidelines, and heuristics for using color in user interfaces and in crt, slide, and paper hardcopy presentation graphics. The course content will cover physiological, perceptual, cognitive, and communication issues. The agenda includes the following topics:

Basic terminology and concepts
Physiological basis of color
Color perception schema
Color models and spaces
Color vision deficiency, illusions
User manipulation and selection
Screen/hardcopy conversion issues
Cognitive issues for usability

Color assignment and coding
Relativity and redundancy
Preferences, performance, learning
User interface design
Psychological, cultural issues
Aesthetics, harmonious palettes
Product identity, marketing issues
Case studies

Lecturers Mr. Aaron Marcus (Chair), Principal
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Chair Biography

Aaron Marcus is founder and principal of Aaron Marcus and Associates. He and his staff research, design, and critique the use of typography, symbolism, color, spatial layout, animation, sequencing, and interaction in computer graphics presentations, user interfaces, electronic publishing formats, and documentation for major US and international firms. Mr. Marcus has written many articles on graphic design for computer graphics, including color, for technical and professional journals. His essay "Color: A Tool for Communication" appears in *The Computer Image* published by Addison-Wesley and his "Ten Commandments of Color" has been reprinted in the *Pantone Color Newsletter*. He serves on a NASA advisory committee for color selection in the US Space Station. He has given screen design, information graphics, and electronic publishing tutorials at major computer graphics conferences and at companies in the USA, Canada, Europe, Israel, and Japan. Mr. Marcus was educated in physics at Princeton and in graphic design at Yale and has taught computer graphics since 1970.

Relation to Previous Tutorials

This tutorial will be similar to the version presented last year, but will include a special emphasis on matching color between crt and hardcopy media. As before, cognitive and communication issues will be emphasized.

Tutorial Outline: Color in Computer Graphics

Goals (Marcus)

Communication

Information

Persuasion

Aesthetics

Ease of learning, memory

Ease of use, performance

Terminology (Murch)

Visible spectrum

Dimensions of color

Dimensions of human vision

Physiology (Murch)

The lens

The retina and optic nerve

Rods and cones

The visual cortex

Color deficiencies

Perception (Murch)

Perception of chromatic color

Perception of achromatic color

Hue, saturation, lightness, brightness

Colorimetry

Color description systems

Color models

- Additive**

- Subtractive**

- Optical**

- Opponent color model**

Color ordering and naming

Color spaces

- RGB**

- CIE**

- HLS**

- Munsell**

- Uniform color spaces**

- Relative strengths and weaknesses**

Color vision deficiency

- Red-green confusion**

- Yellow-blue confusion**

Color illusions

- Simultaneous contrast**

- Accommodation**

User interface issues

- Depiction of color spaces on crt's**

- Manipulation**

- Selection**

- Use of AI to provide expertise**

- Screen/hardcopy conversion issues**

- Differing color gamuts**

- Gray scale**

Different media

Screen

Slides

Overhead

Film

Video

Paper

Principles of color reproduction

Case Studies

Solids depiction

Presentation graphics

Cognitive Aspects Related to Usability (Murch and Marcus)

Assignment of meaning: color coding

Relativity

Redundancy

Preferences

Creating impressions

Impacting performance

Learning

Case studies

Communication and Aesthetics (Marcus)

Syntactics

Figure-field

Color palettes, schemes, and harmonies

Color composition, hierarchy, emphasis

Color naming

Berlin and Kay's work

Universal color terms (NBS)

Semantics

Denotation schema

Short-term (7 ± 2 items) vs. long-term
memory

Scales

Blue > red

Gray > color > white

Common denotations

Red: danger, stop, hot, fire

Yellow: warning, caution

Green: ok, proceed, vegetation

Blue: cool, water

Professional palettes

CAD/CAM

Process control

VLSI

Architecture and urban planning

Quantitative vs. qualitative denotation

Connotation issues

Expression

Historical relations

Fashions

Cultural influences

Advanced user interface design issues

Levels

Operating system vs. application

Components

Screen

Windows

Icons

Cursors

Mail

Help

Desk accessories

History

Navigation

Pragmatics (Marcus)

Legibility of type and graphics

Buyers vs. users

Novices vs. experts

Hardcopy device conversion capabilities

Thermal

Electrostatic

Dot matrix printers

Laser printers

Ink jet printers

Slides

Offset printing

Color matching systems (Pantone, Munsell)

Other media

Cosmetics

Inks

Textiles

Paints

Product and corporate identity: look and feel issues

Persuasive communication: advertising, emotions

Case studies

Graphic arts workstation

Business graphics

Desktop slidemaking

CAD/CAM systems

AI and expert systems

Complex data display

Closing remarks (Marcus)

Tutorial Schedule

8:30- 8:45	Introduction (Marcus)
8:45-10:00	Terminology, physiology, perception (Murch)
10:00-10:15	Morning break (approximate)
10:15-12:00	Terminology, physiology, perception, continued (Murch)
12:00- 1:30	Lunch
1:30- 3:00	Cognitive aspects (Smith)
3:00- 3:15	Afternoon break (approximate)
3:15- 4:45	Communication, aesthetics (Marcus)
4:45- 5:00	Closing remarks, questions (Marcus)