南京大学
NANJING UNIVERSITY

人机交互系统

基础知识

主讲教师：冯桂焕

■人的认知

信息处理模型

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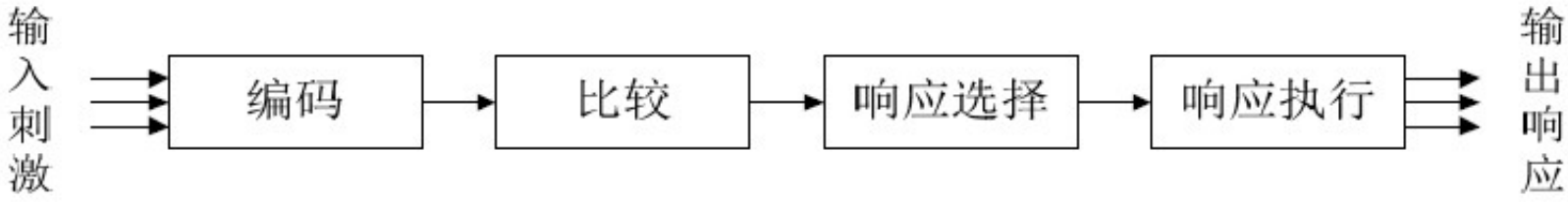
■作用

●研究人对外界信息的接收、存储、集成、检索和使用，可预测人执行特定任务的效率，如可推算人需要多长时间来感知和响应某个刺激（又称“反应时间”），信息过载会出现怎样的瓶颈现象等

■信息处理机，Lindsay和Norman

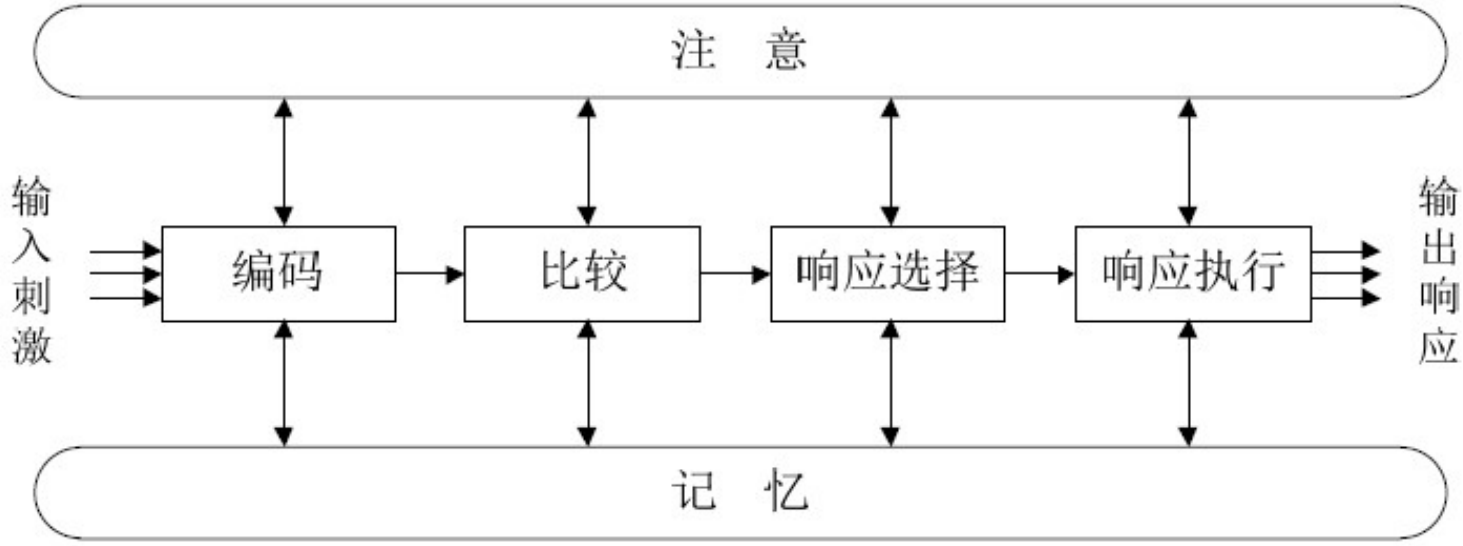
●没有考虑到注意和记忆的重要性



扩展的信息处理机模型

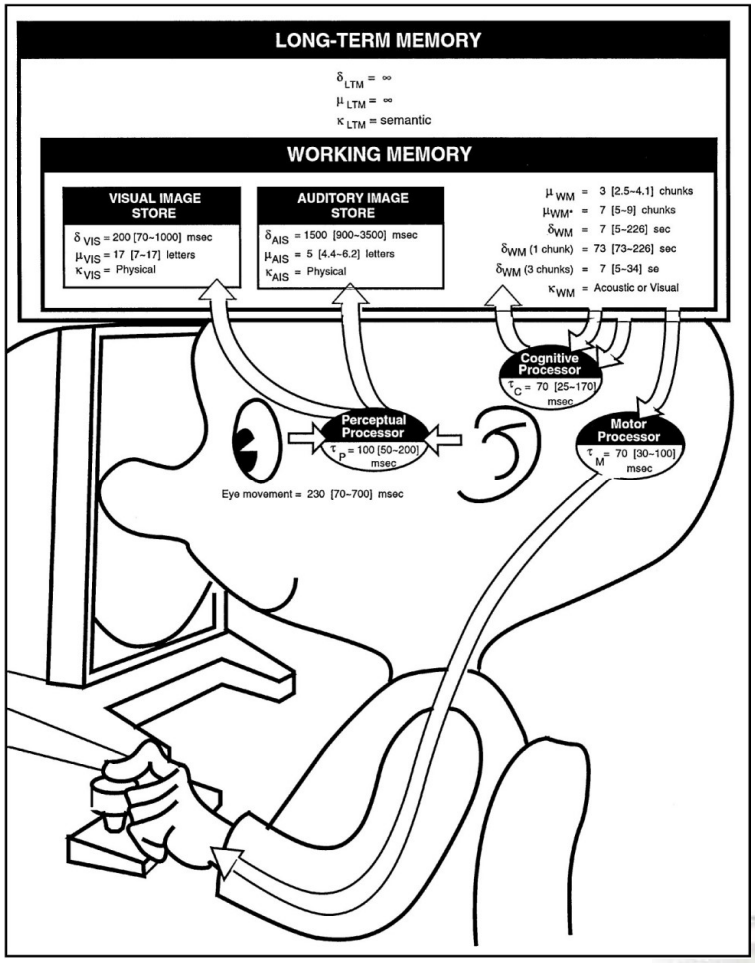
■Barber对其进行了扩展

●注意和记忆功能与信息处理过程的各个阶段存在交互



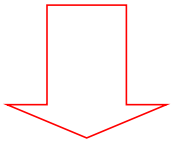
人类处理机模型

- 最著名的信息处理模型
- Card等，1983
- 包含三个交互式组件
- 感知处理器
  - 信息将被输出到声音存储和视觉存储区域
- 认知处理器
  - 输入将被输出到工作记忆
- 动作处理器
  - 执行动作



■存在的问题

- ●把认知过程描述为一系列处理步骤
- ●仅关注单个人和单个任务的执行过程
  - ●忽视了复杂操作执行中人与人之间及任务与任务之间的互动
- ●忽视了环境和其他人可能带来的影响



- ●外部认知模型、分布式认知模型

认知心理学

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■兴起于20世纪50年代中期

■关注人的高级心理过程，如记忆、思维、语言、感知和问题解决能力等

- 神经元网络已经成为新一代人工智能领域最热门的研究课题之一

■对HCI的贡献

- 有助于理解人与计算机的交互过程，同时也可对用户行为进行预测
- 人对于外界的感知有80%来自于视觉获取的信息

格式塔（Gestalt）心理学

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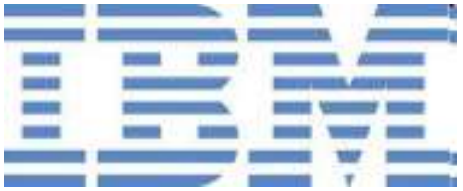
■研究人是如何感知一个良好组织的模式的，而不是将其视为一系列相互独立的部分

- ●事物的整体区别于部分的组合



■ “Gestalt”

- ●德语，“完形（configuration）”或“型式（pattern）”
- ●格式塔心理学又称完形心理学

■表明

- ●用户在感知事物的时候总是尽可能将其视为一个“好”的型式

■相近性原则、相似性原则、连续性原则、完整性和闭合性原则

相近性原则

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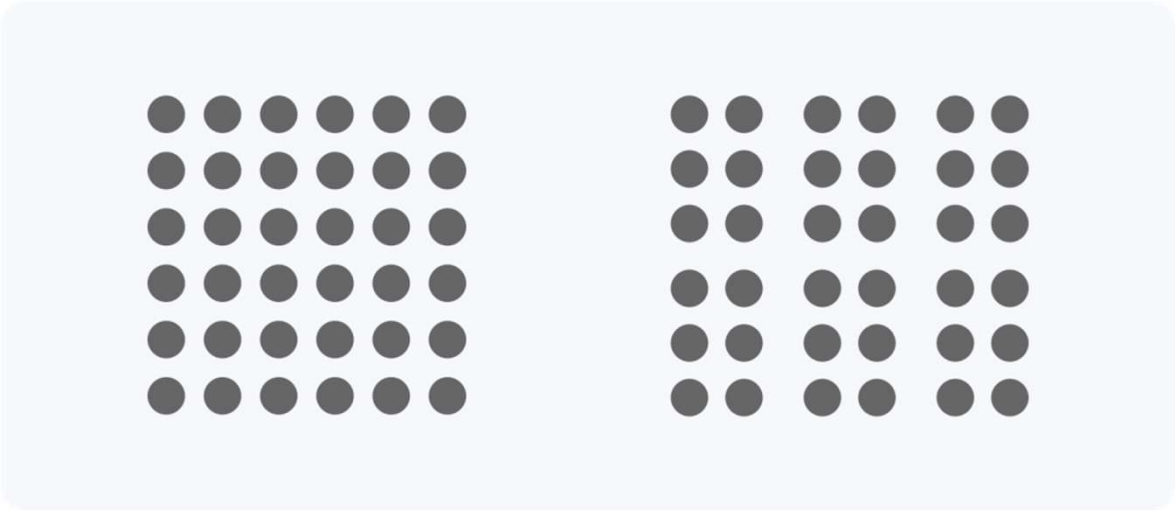
■空间上比较靠近的物体容易被视为整体

●设计界面时，应按照相关性对组件进行分组

■如下图，你看到了什么？



图片取自https://www.woshipm.com/ucd/5811028.html

相近性原则

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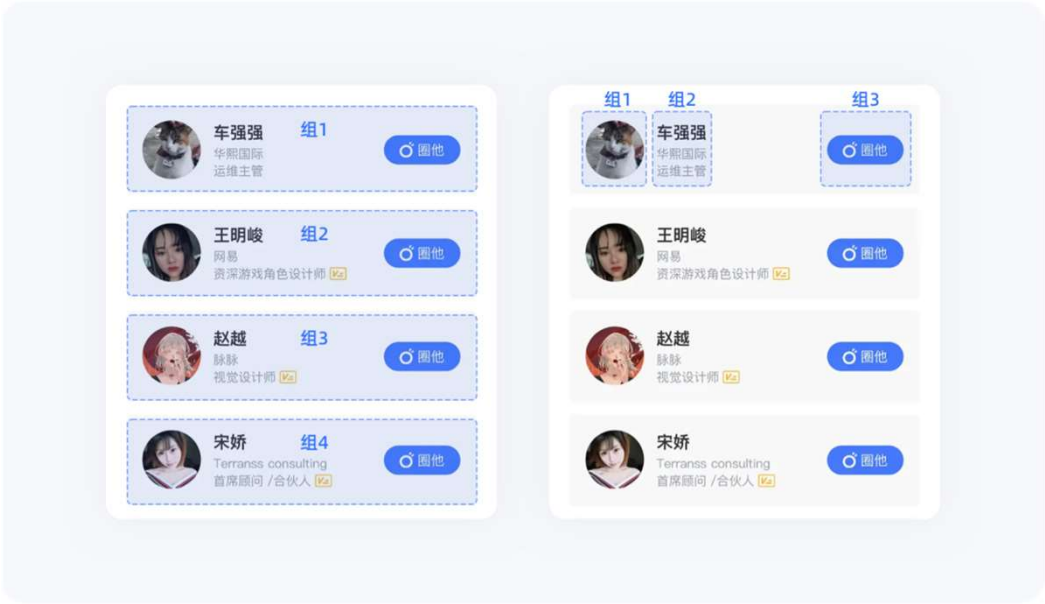
■应用

●合理运用接近性法则，它能让界面层次清晰有序。

●例如列表页设计，将相关的信息组合在一起并重复排列出来，就能明显感知不同小组之间的界限，当同一小组内元素关系明确时，将其更加靠拢，用户视觉就会更聚焦。



相似性原则

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■人们习惯将看上去相似的物体看成一个整体

●功能相近的组件应该使用相同或相近的表现形式

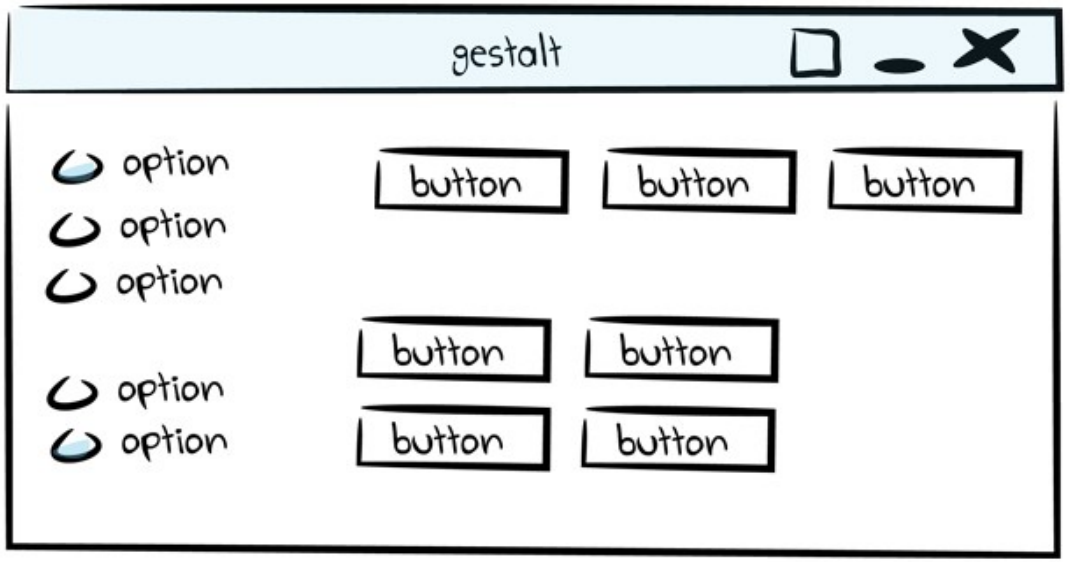
■这一次呢?

相似性原则

■应用

●使用不同的大小、颜色、形状来创建对比或视觉权重，呈现出不一样的视觉效果，以达到弱化（降低视觉）或凸显（强化视觉）某些内容

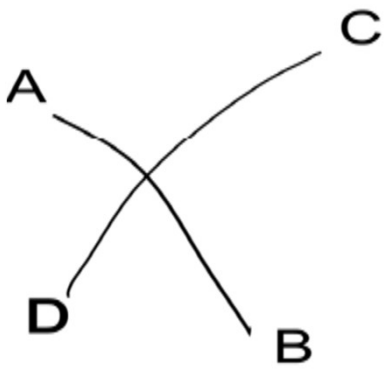
格式塔心理学与界面感知

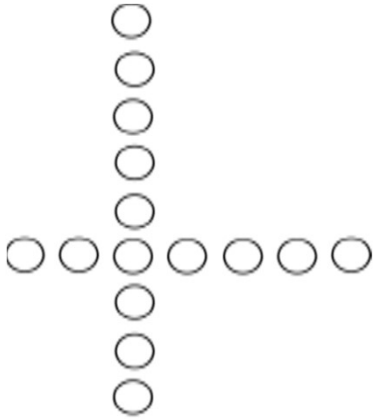


连续性原则

■共线或具有相同方向的物体会被组合在一起

●将组件对齐，更有助于增强用户的主观感知效果





对称性原则

■相互对称且能够组合为有意义单元的物体会被组合在一起

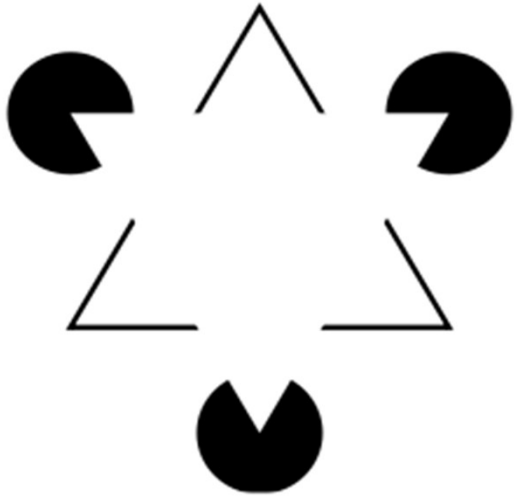
■相近性？对称性？

[ ][ ][ ]

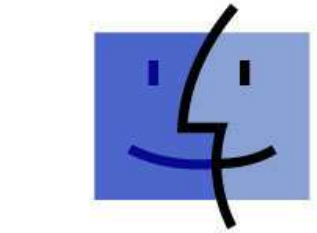
完整和闭合性原则

■人们倾向于忽视轮廓的间隙而将其视作一个完整的整体

●页面上的空白可帮助实现分组



前景&背景



Mac OS

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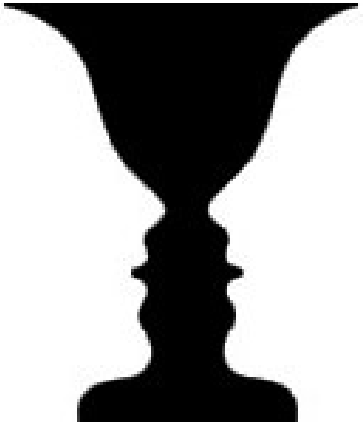
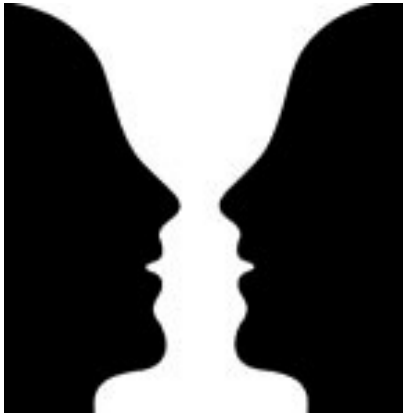
■前景和背景在某些情况下可以互换

- “整体区别于局部”





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屏幕格式塔

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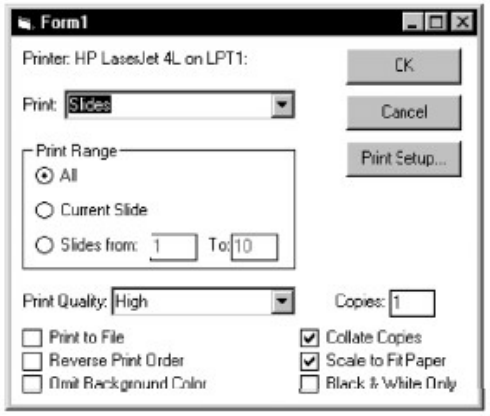
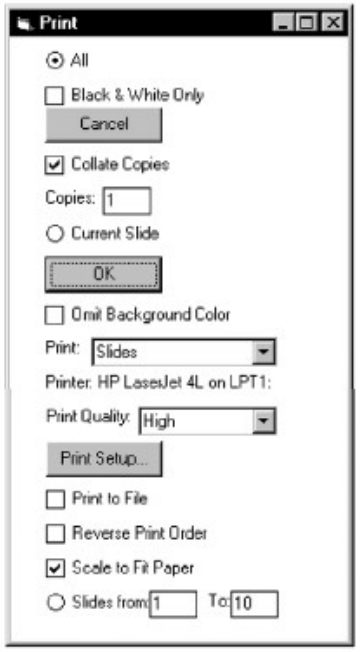
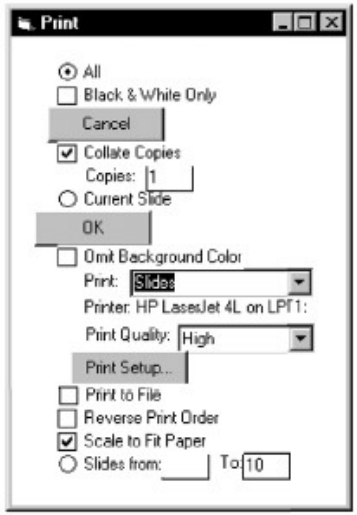
■Law of lines

A B



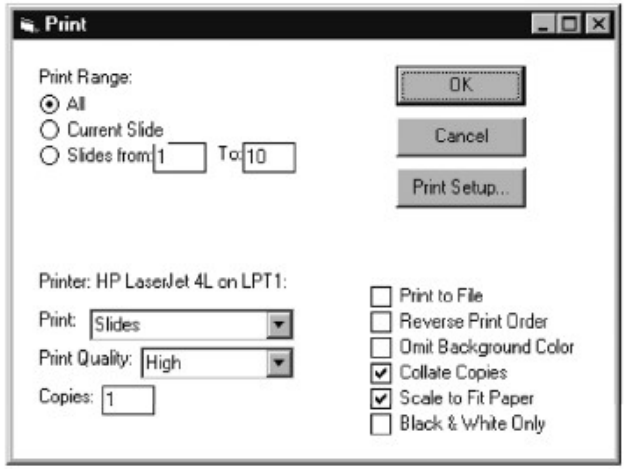


C

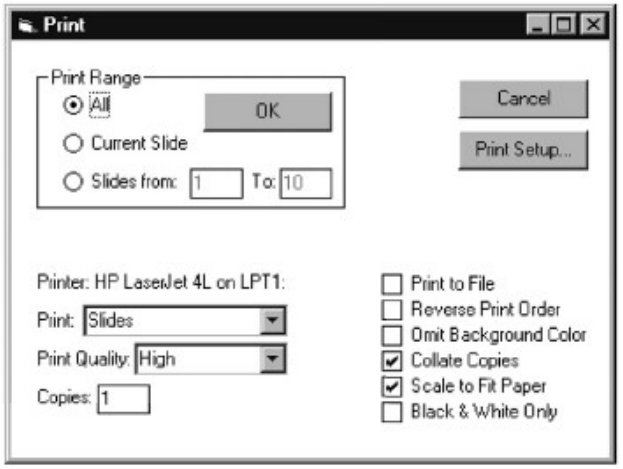


■Proximity and Closure

D



E



格式塔心理学会对如何理解界面产生深刻影响

文字格式塔

Introduction & Basic Concepts.....7
The role of requirements.....8
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Contents of the specification.....13
Problems observed in practice.....16
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The goal–design scale.....20
Typical project models.....24
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The data model.....30
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Sequence diagrams.....103
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Reports.....107
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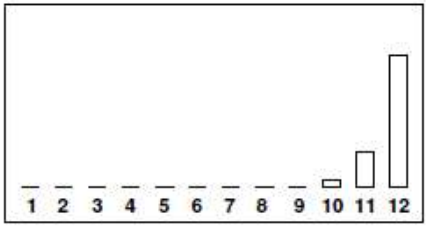
Product integration – main contractor.....114
Technical interfaces.....115
Quality requirements.....117
Quality Factors.....118

标题格式塔

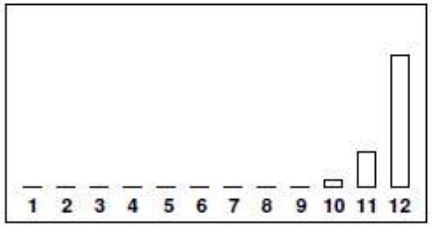
■如何理解粗体字?



Sales of X-mas trees

There is a strong seasonal variation in the sales of . . .

Picture caption or heading?



Sales of X-mas trees
There is a strong seasonal variation in the sales of . . .

No doubt

段落格式塔

1

This report is intended to provide background information which will facilitate the development of procedures and tools to improve the tware producers to manage and control software quality and to demonstrate the achievement of software quality requirements.

The report surveys published work relating to the identification and specification of software quality characteristics, metrics relating to them, and inferences which can be drawn from the metrics. It does not attempt, however, to evaluate the published work to any great extent. It notes the ure, and identifies uality Management project. In summarising such large works it has not been possible to cover all the material, and the serious student may need to refer to the originals for further details.

Boehm et al's book entitled "Characteristics of Software Quality" reports on work done in the early seventies and is a precursor not only or McCall et al's work but also of Gilb's. The initial objectives of the study were to identify a set of characteristics of software quality, and for each characteristic to aimed at measuring the degree to which a program possesses the characteristic and hence provide an overall software quality assessment.

(Boehm et al soon abandoned the idea of an overall quality since they argued that the quality requirements for a given product will vary with the needs and priorities of the user, so there could be no single universally useful rating of software quality. They concluded that metrics would be best used as anomaly indicators - ie to note that an item of software differed from the normal pattern in a way that might be symptomatic of quality problems.)

2

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线的长度/文本宽度

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- ■回溯Retracing
  - ●段落太宽，不容易找到下一行的开始
- ■扫视Saccades
  - ●只有注视能看到内容
  - ●每隔15~30个字符（依赖于文字难度、阅读技能等）就要停下来注视
- ■不成文规定
  - ●line length at most 12.5 cm (5 inches)
  - ●lines at most 65 characters (average, excluding spaces)

3

This report is intended to provide background information which will facilitate the development of procedures and tools to improve the ability of software producers to manage and control software quality and to demonstrate the achievement of software quality requirements.

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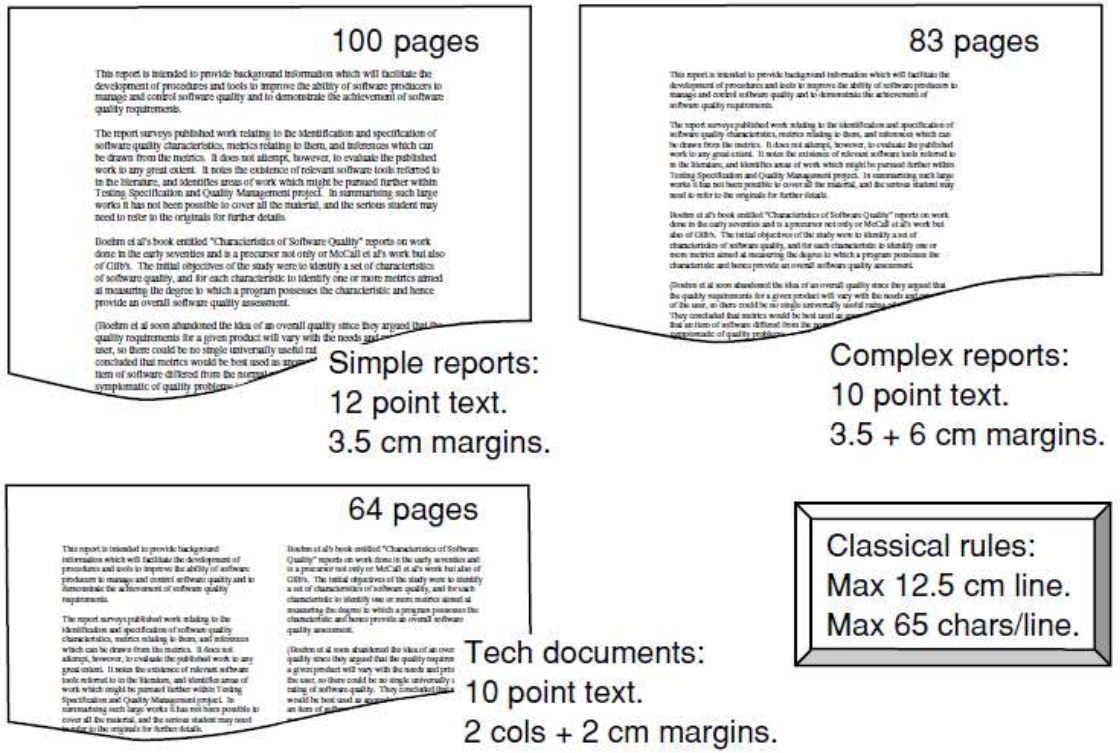
Clear gestalts
but lines too long.
Annoying to read.

约定

Fig 3.3 D Line length, A4 or Letter paper



格式塔心理学反例

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■对比Constract

●让重点更突出！

几种不同形式的对比

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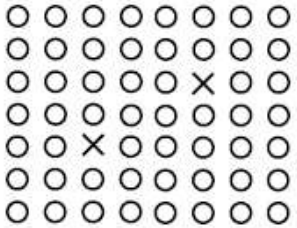
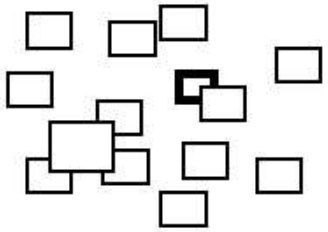
Form



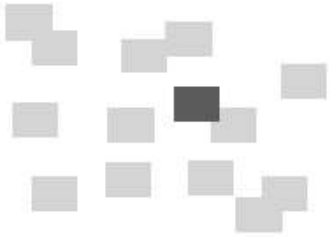
Size, thickness, or 3-D

mm dmsm s p ab anem a tts, to fmst saâfprs fer s frfi smfe skf org s fp4et gsæ fgtær mm dmsm sp ab anem a tts , to fmst saâfprs fer s frfi smfe skf org s fp4et gsæ fgtær mm dmsm sp. ab anem fmst saâfprs fer s frfi smfe skf org s fp4et gsæ fgtær mm dmsm sp ab anem a tts , to fmst saâfprs fer s frfi smfe skf org s fp4et gsæ fgtær mm dmsm sp ab anem a tts, to fmst saâfprs fer s frfi smfe skf org s fp4et gsæ fgtær mm dmsm sp ab anem a tts , to fmst saâfprs fer s frfi smfe skf org s fp4et gsæ

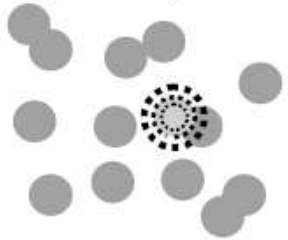


Colour or darkness

mm dmsm sp ab anem a tts , to fmst saâfprs fer s frfi smfe skf org. Tts to fer s frfi smfe skf Org s fp4et gsæ fgtæ r mm dmsm sp ab anem a tts , to fmst saâfprs fe r s frfi smfe skf org s fp4et gsæm dmsm



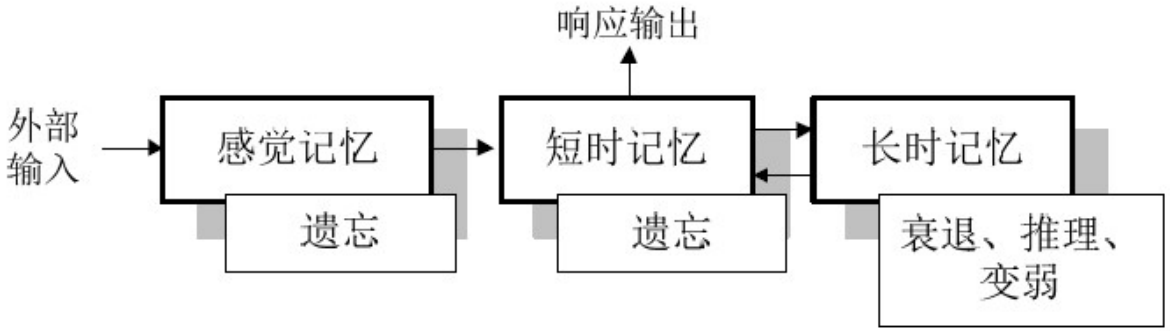
Flash or movement (intense)



人脑中的记忆结构

■三个阶段，Atkinson和Shiffrin

- ●感觉记忆
- ●短时记忆
- ●长时记忆
- ●三个阶段之间可以进行信息交换



关于记忆

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■感觉记忆

- ●又称瞬时记忆
- ●在人脑中持续约为1秒钟
- ●帮助我们把相继出现的一组图片组合成一个连续的图像序列，产生动态的影像信息

■短时记忆

- ●感觉记忆经编码后形成
- ●又称工作记忆，约保持30秒
- ●储存的是当前正在使用的信息，是信息加工系统的核心，可理解为计算机的内存
- ●短时记忆的存储能力约为7±2个信息单元

STM测试

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■6, 12, 71, 2, 93, 74, 0, 21, 19, 38, 8, 15, 4

■猫, 房子, 纸, 笑, 人, 红色, 是的, 数字, 阴影, 下雨, 植物, 灯泡, 巧克力, 收音机, 一, 硬币, 直升机

■t, k, s, y, r, q, x, p, a, z, l, b, m, e

■8,6,2,5,8,3,6,2,1,3,6,0,9,0,7

- ●通过将信息组合成一个个有意义的单位可以帮助我们记住复杂的信息
- ●86-25-8362 1360-907

游戏

- 从第一个人开始说
  - “我去超市，买了一条鱼”（或者别的任何东西）。
- 下一个人继续说“我去超市，买了一条鱼，还买了一个面包”。
- 不断继续，每次每个人都在列表里增加某个物品
- 当第一次有某个人出错时，记下能够成功记住的物品数目。

7±2理论 vs. 交互式系统设计

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■影响

- ●菜单中最多只能有7个选项
- ●工具栏上只能显示7个图标
- ●……

■事实

- ●浏览菜单和工具栏基于人的识别功能
  - ●人们识别事物的能力要远胜于回忆事物的能力
- ●界面设计时要尽可能减小对用户的记忆需求，同时可考虑通过将信息放置于一定的上下文中，来减少信息单元的数目

长时记忆

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- 短时记忆->长时记忆
  - 短时记忆中的信息经进一步加工后会变为长时记忆
  - 只有与长时记忆区的信息具有某种联系的新信息才能够进入长时记忆
- 长时记忆的信息容量几乎是无限的
- 启发
  - 注意使用线索来引导用户完成特定任务
  - 在追求独特的创新设计时也应注重结合优秀的交互范型

■遗忘

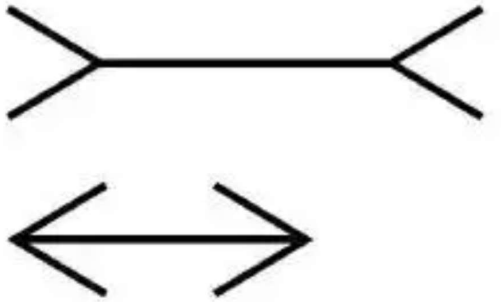
- ●长时记忆中的信息有时是无法提取
- ●不代表长时记忆区的信息丢失了

■易出错

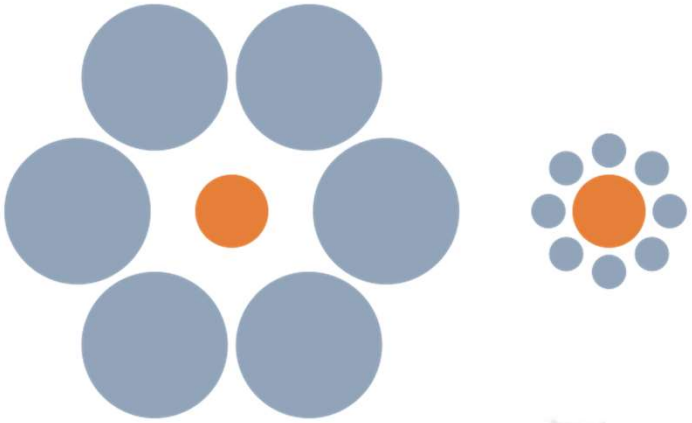
- ● “人为错误”被定义为“人未发挥自身所具备的功能而产生的失误，它可能降低交互系统的功能”
- ●从表面上看是由于用户的误解、误操作或一时大意
- ●大部分交互问题都源于系统设计本身

视错觉

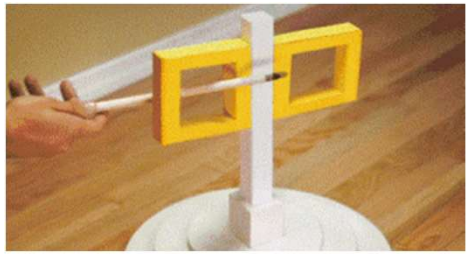
- ■知觉感受的扭曲
  - ●前后景互换实际上就是视错觉的一种
  - ●白色三角的例子
- ■视错觉是不可避免的
- ■启示
  - ●对于物体的视觉感知与物体所处的上下文密切相关



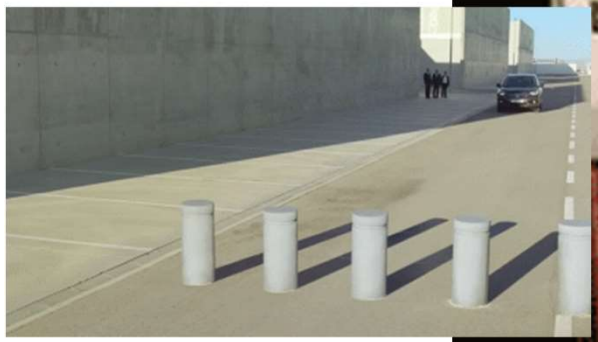
莱亚错觉

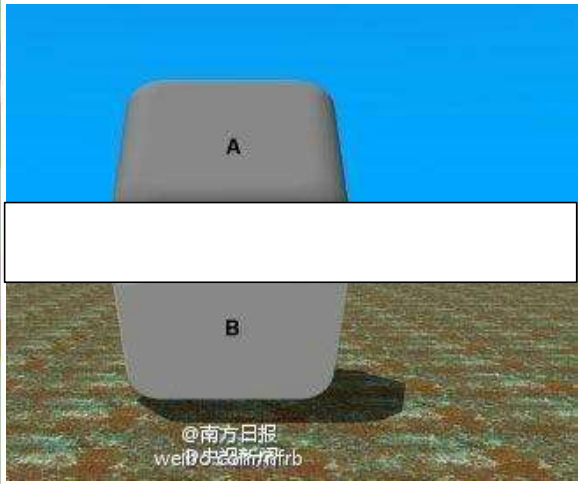


艾宾豪斯错觉

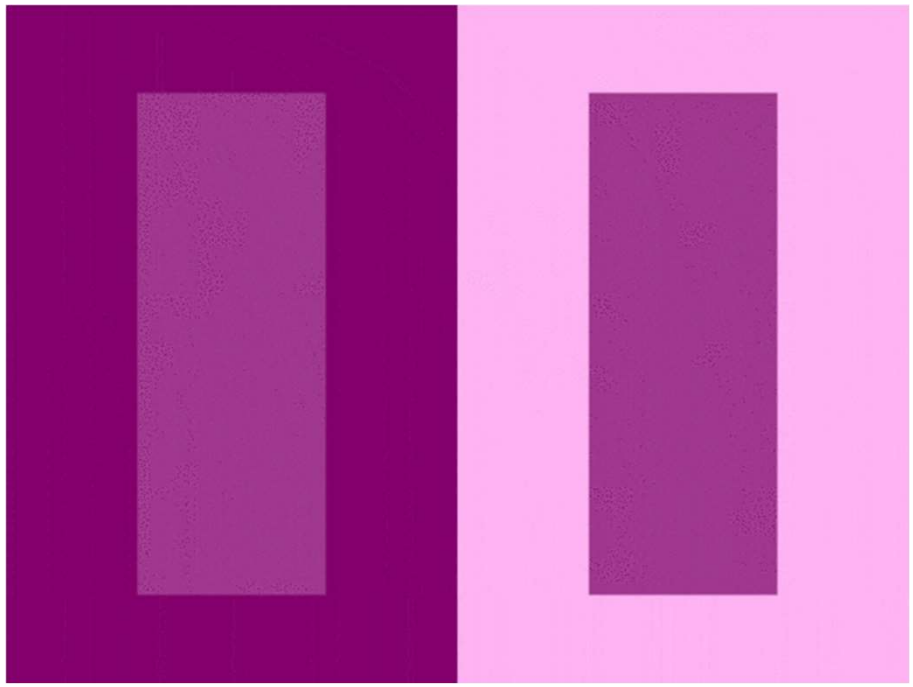



gifcool.com





■如果你看到的是＂蓝＋黑＂那么证明你视网膜上的视锥细胞拥有较高色彩感知能力，这导致你的眼睛能够主动排除掉一部分的干扰来观察到最真实的色彩。而如果你看到的是＂白＋金＂，那么证明你的眼睛在低光条件下会对色彩的感知产生偏差，造成颜色的混合（比如红和绿），因此你会在图片中看到金色。



把两个同色的物体分别放在不同对比度的背景色上，会使两个物体呈现出不同的颜色。这种现象被称为「同时对比错觉」

视觉感知&上下文

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■你从图中看到了什么?

提示：一只面向你的动物

提示：它的头在左侧，能产奶

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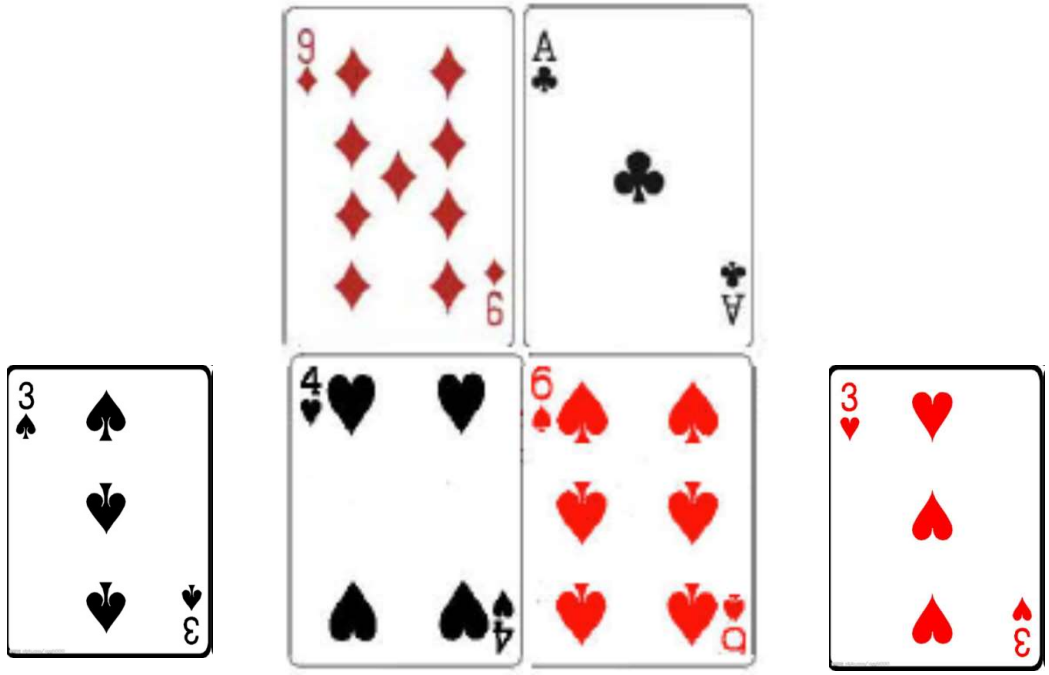
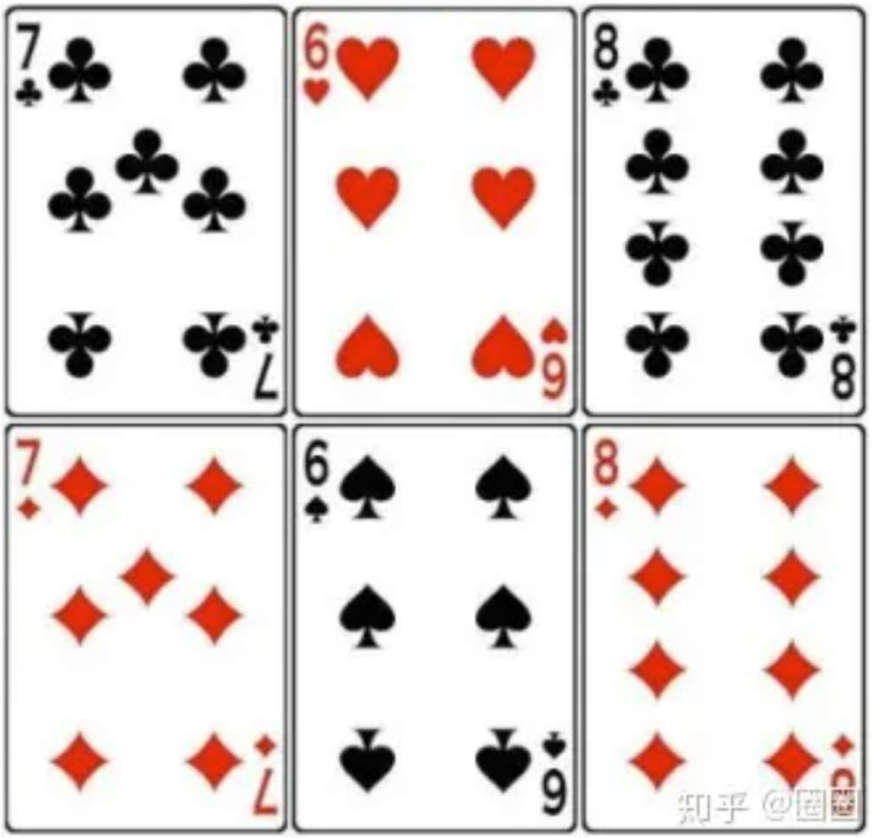
■上下文信息有助于增强人们的视觉感知

期望对感知的影响

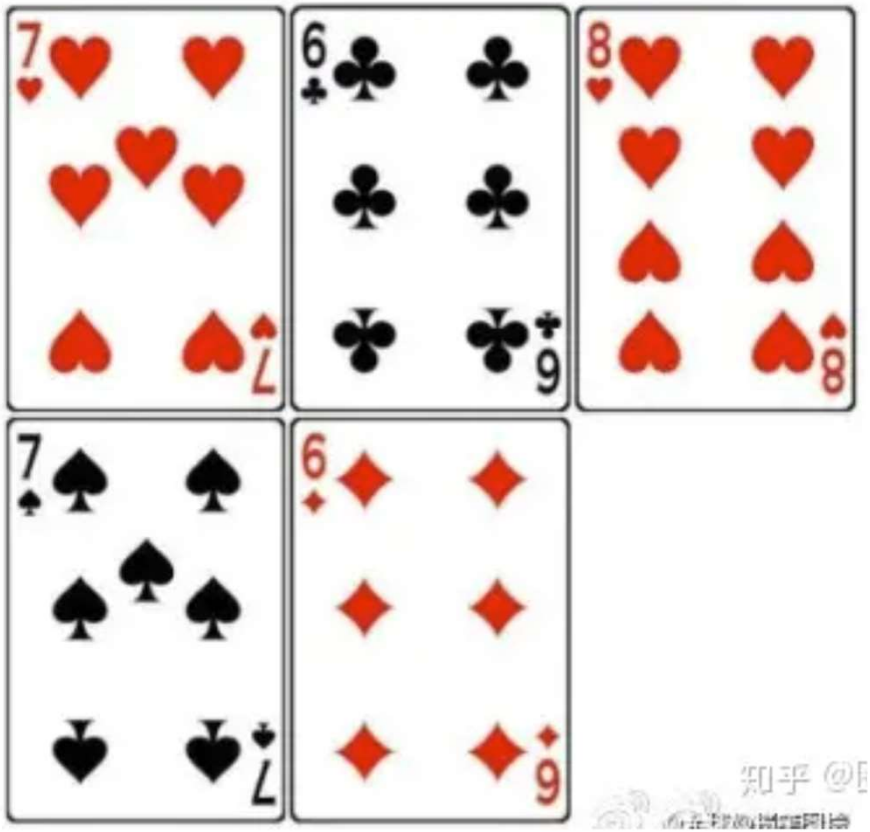


From: after Bruner and Postman, 1949, pp. 206 – 23.

■请你任意选一张并记住数字与花色。



■你记住的那张牌不见了



字母顺序重要么?

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■ ***"From Cambridge University .***

Olny srmat poelpe can raed tihs.
I cdnuolt blveiee taht I cluod aulaclty uesdnatnrd waht I was rdanieg.
The phaonmneal pweor of the hmuan mnid, aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn't mttaer in waht oredr the ltteers in a wrod are, t he olny iprmoatnt tihng is taht the frist and lsat ltteer be in the rghit pclae. The rset can be a taotl mses and you can sitll raed it wouthit a porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe. Amzanig huh? yaeh and I awlyas tghuhot slpeling was ipmorantt!"

中文呢?

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■研表究明，汉字的序顺并不定一能影阅响读，比如当你看完这句话后，才发这现里的字全是都乱的。

压力指数测试

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■日本神经学博士山本先生创作

●如果看到的它是不动的，或者只是稍微的动一下下

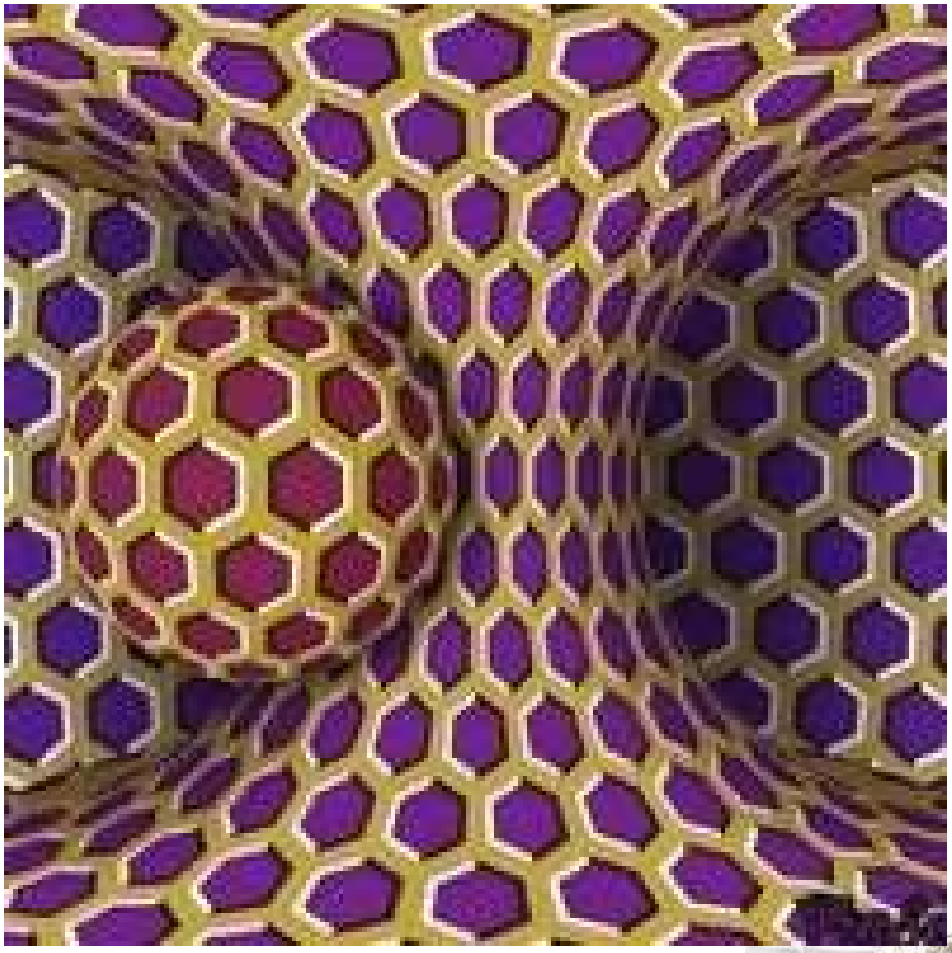
●那说明你是健康的，啥都好，继续保持良好的状态

●如果看到的它移动的很慢

●说明你有点压力和疲惫，要调整一下

●如果你看到的它一直不停的在动

●说明你压力有点大，需要好好的休息调整



■界面类型

基于命令的界面

- 用户通过在屏幕某个位置上键入特定命令或靠组合键的方式来执行任务
- 优点
  - 专家用户能够快速而精确地完成任务；
  - 较GUI节约系统资源；
  - 可动态配置可操作选项；
- 设计和研究问题
  - 命令的形式、语法和组织
  - 选择易于标记/命名命令的方法应尽可能一致

Figure 1: Scene in Second Life

WIMP和GUI

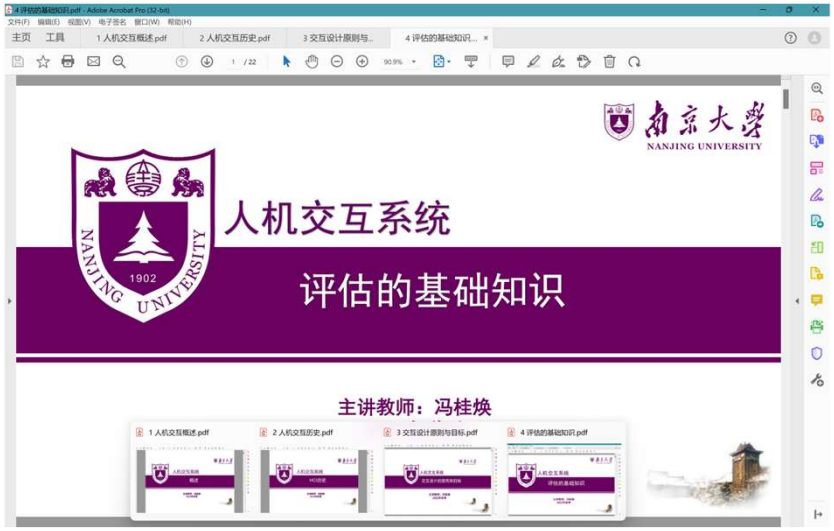
■WIMP和GUI的全称

- ●Window, Icon, Menu, Pointing
- ●Graphical User Interface

■今天的WIMP组件已经演变成多种不同形式和类型

■ 设计和研究问题

- ●如何进行窗口管理，找到内容并在不同窗口之间流畅切换
- ●确定菜单选项的最佳术语
- ●消除图标的歧义



多媒体界面

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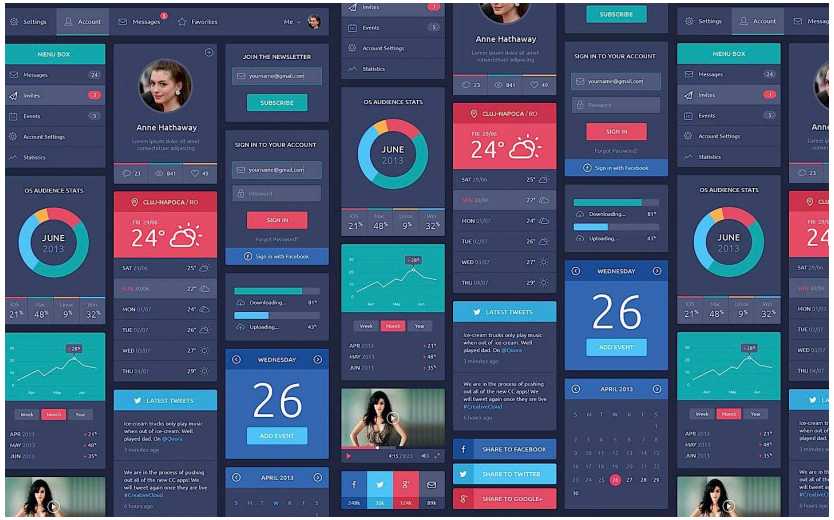
■在单个界面中组合不同的媒体，即图形、文本、视频、声音和动画，并将他们与各种形式的交互相连接

■优点

- ●媒体和交互性的组合可以比其中任何一个提供更好的呈现信息的方式
- ●增强了快速访问多种信息的能力
- ●更易学习、更好理解、更多的参与度和乐趣

■研究和设计问题

- ●多媒体内容设计
  - ●何时使用音频与图形、声音与动画等



虚拟现实和增强现实

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■Virtual Reality & Augmented Reality

■VR提供了新的身临其境的体验，用户能够与对象交互并在3D空间中导航，区别于物理世界或2D图形界面

■研究和设计问题

- ●如何防止用户体验不好的事情
- ●确保用户使用最有效的导航方式，如第一人称、第三人称
- ●如何使用户与虚拟环境中的其他人协作和沟通

信息可视化和仪表盘

■信息可视化

●通过计算复杂数据生成的图形，通常是可交互且动态的，其目标是提高发现、决策、解释现象的能力

■仪表盘

●一种日益流行的可视化信息形式，往往是不可交互的，数据旨在描述系统或过程的当前状态

■研究和设计问题

■设计一个易于理解和容易推理的可视化

■是否使用动画或可交互

■2D或3D?

■何种隐喻?

笔式交互和触摸交互


LEDs
Camera
Touch sensors


ShapeWriter is easy


Tilt Brush
by Google

手势界面

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■借助相机、传感器和计算机视觉技术，可以准确识别人的身体、手臂和手势

- ●可适用于双手不方便操作的时候
  - ●家电控制、手术室、
- ●你知道哪些不同的手势识别机制？

■设计和研究问题

- ●计算机如何识别和描绘用户的手势
- ●如何确定手势运动的开始和结束

■有时，如打球时，手持设备会体验更好

实物界面Tangible Interface

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■通常基于传感器，物理对象与数字表示相结合

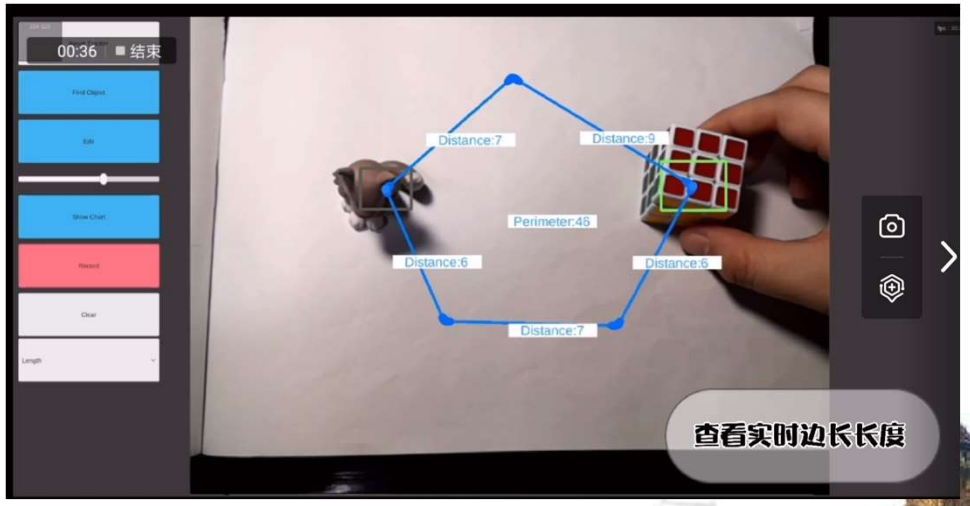
- ●当操纵物理对象时，检测到物理对象中的变化从而引起数字效应

■优点

- ●可以创造性地操纵，使得动态信息以不同方式呈现
- ●支持多人一起探索

■研究和设计问题

- ●物理活动和效果之间应该如何组合
- ●使用何种实物来使用户能够以自然的方式执行活动



可穿戴计算

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■研究和设计问题

●舒适、卫生、续航、交互方式的选择……

脑机界面

GUI的演化

■更少的记忆、更多的识别、更少的键盘和点击、更不易出错、以及更可视的上下文

a. Command line