

# Chapter 17

## Chapter 17 User Interface Design



### Learning Objective

... Define the basic *design principles*, user-system interaction, *information presentation*, user guidance, and *interface evaluation*

**Frederick T Sheldon**

Assistant Professor of Computer Science  
Washington State University

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## User interface design

Designing graphical interfaces  
for software systems

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## Objectives

- To suggest some general design principles for user interface design
- To describe direct manipulation interfaces
- To discuss factors to be considered when designing information presentations
- To describe the user support which should be built-in to user interfaces
- To introduce usability attributes and system approaches to system evaluation

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## Topics covered

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- Design principles
- User-system interaction
- Information presentation
- User guidance
- Interface evaluation

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## The user interface

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- System users often judge a system by its interface
- A poorly designed interface can cause a user to make catastrophic errors
- Poor user interface design is the reason why so many software systems are never used
- Focus in this chapter is on graphical user interface design

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## Graphical user interfaces

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- User interfaces which rely on windows, iconic representation of entities, pull-down or pop-up menus and pointing devices.
- Previously called WIMP interfaces - now generally referred to as GUIs.
- The standard form of interface for workstations and high-power personal computers.

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## GUI characteristics

Characteristic	Description
Windows	Multiple windows allow different information to be displayed simultaneously on the user's screen.
Icons	Icons different types of information. On some systems, icons represent files; on others, icons represent processes.
Menus	Commands are selected from a menu rather than typed in a command language.
Pointing	A pointing device such as a mouse is used for selecting choices from a menu or indicating items of interest in a window.
Graphics	Graphical elements can be mixed with text on the same display.

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## GUI advantages

They are easy to learn and use.

Users without experience can learn to use the system quickly.

The user may switch quickly from one task to another and can interact with several different applications.

Information remains visible in its own window when attention is switched.

Fast, full-screen interaction is possible with immediate access to anywhere on the screen

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## Design principles

UI design must take account of the needs, experience and capabilities of the system users

Users should be involved in the design process and user interface designs should be refined through rapid prototyping

There are cognitive factors, such as the size of short-term memory, which user interface designers must be aware of

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# User interface design principles

Principle	Description
User familiarity	The interface should use terms and concepts which are drawn from the experience of the anticipated class of user.
Consistency	The interface should be consistent in that comparable operations should be activated in the same way.
Minimal surprise	Users should never be surprised by the behaviour of a system.
Recoverability	The interface should include mechanisms to allow users to recover from their errors.
User guidance	The interface should incorporate some form of context-sensitive user guidance and assistance.

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# Design principles

The interface should be based on user-oriented terms and concepts rather than computer concepts

For example, an office system should use concepts such as letters, documents, folders etc. rather than directories, file identifiers, etc.

The system should display an appropriate level of consistency

Commands and menus should have the same format, command punctuation should be similar, etc.

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# Design principles

The system should not surprise the user

If a command operates in a known way, the user should be able to predict the operation of comparable commands.

The system should provide some resilience to user errors and allow the user to recover from errors

This might include an undo facilities, confirmation of destructive actions, 'soft' deletes, etc.

Some user guidance should be supplied

Help systems, on-line manuals, etc.

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## User-system interaction

Two problems must be addressed in interactive systems design

How should information from the user be provided to the computer system?

How should information from the computer system be presented to the user?

User interaction and information presentation may be integrated through a coherent framework such as a user interface metaphor

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## Direct manipulation

A direct manipulation interface presents the user with a model of their information space which is modified by direct action e.g. names are changed by typing the new name over them

A form interface is a simple example of a direct manipulation interface

GUI's provide some direct manipulation e.g. files can be deleted by moving icons to a trashcan

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## Form-based interface

NEW BOOK			
Title	<input type="text"/>	ISBN	<input type="text"/>
Author	<input type="text"/>	Price	<input type="text"/>
Publisher	<input type="text"/>	Publication date	<input type="text"/>
Edition	<input type="text"/>	Number of copies	<input type="text"/>
Classification	<input type="text"/>	Loan status	<input type="text"/>
Date of purchase	<input type="text"/>	Order status	<input type="text"/>

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## Direct manipulation advantages

Users feel in control of the computer and are less likely to be intimidated by it

User learning time is relatively short

Users get immediate feedback on their actions so mistakes can be quickly detected and corrected

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## Direct manipulation problems

The derivation of an appropriate information space model can be very difficult

Given that users have a large information space, what facilities for navigating around that space should be provided?

Direct manipulation interfaces can be complex to program and make heavy demands on the computer system

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## Interface models

### Desktop metaphor.

The model of an interface is a (kind of) desktop with icons representing files, cabinets, etc.

### Control panel metaphor.

The model of an interface is a hardware control panel with interface entities including:

- » Buttons.
- » Switches
- » Menus
- » Lights
- » Displays
- » Sliders

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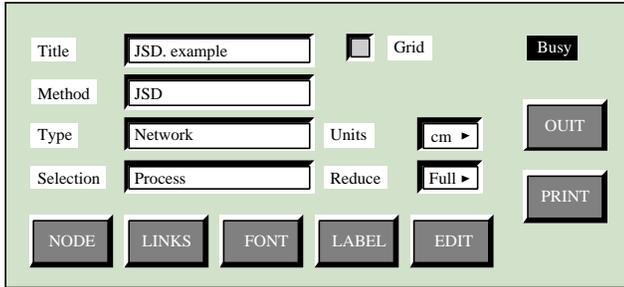
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## Control panel interface



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## Menu systems

Users make a selection from a list of possibilities presented to them by the system

The selection may be made by pointing and clicking with a mouse, using cursor keys or by typing the name of the selection

May make use of simple-to-use terminals such as touch screens

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## Advantages of menu systems

Users need not remember command names as they are always presented with a list of valid commands

Typing effort is minimal

User errors are trapped by the interface

Context-dependent help can be provided. The user's context is indicated by the current menu selection

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## Problems with menu systems

Actions which involve logical conjunction (and) or disjunction (or) are awkward to represent

Menu systems are best suited to presenting a small number of choices. If there are many choices, some menu structuring facility must be used

Experienced users find menus slower than command language

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## Menu structuring

### Scrolling menus

When a choice is not displayed, the menu can be scrolled to reveal more choices. Not practical if there is a very large number of choices

### Hierarchical menus

The menus are organized in a hierarchy. Selecting a menu item causes the menu to be replaced by a sub-menu

### Walking menus

A menu selection causes another menu to be revealed

### Associated control panels

When a menu item is selected, a control panel pops-up offering further options

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## Walking menus

Times  
Helvetica  
Palatino  
Bookface  
Frutiger  
Gothic  
Symbol

9 Point  
10 Point  
12 Point  
14 Point  
18 Point  
24 Point  
36 Point  
48 Point

Plain  
**Bold**  
*Italic*  
**Outline**  
Underline  
Shadow

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## Command interfaces

User types commands to give instructions to the system e.g. UNIX

May be implemented using cheap terminals.

Easy to process using compiler techniques

Commands of arbitrary complexity can be created by command combination

Concise interfaces requiring minimal typing can be created

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## Problems with command interfaces

Users have to learn and remember a command language. Command interfaces are therefore unsuitable for occasional users

Users make errors in command. An error detection and recovery system is required

System interaction is through a keyboard so typing ability is required

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## Command languages

Often preferred by experienced users because they allow for faster interaction with the system

Not suitable for casual or inexperienced users

May be provided as an alternative to menu commands (keyboard shortcuts). In some cases, a command language interface and a menu-based interface are supported at the same time

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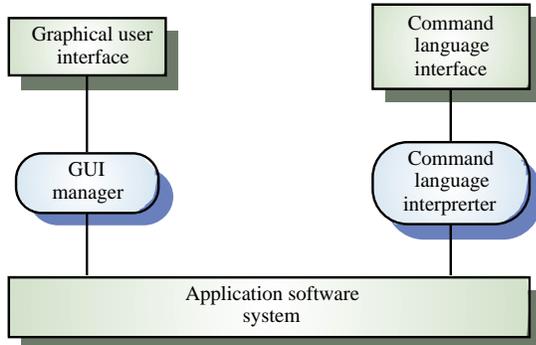
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## Multiple user interfaces



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## Information presentation

### Static information

Initialized at the beginning of a session. It does not change during the session  
May be either numeric or textual

### Dynamic information

Changes during a session and the changes must be communicated to the system user  
May be either numeric or textual

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## Information display factors

Is the user interested in precise information or data relationships?

How quickly do information values change?

Must the change be indicated immediately?

Must the user take some action in response to a change?

Is there a direct manipulation interface?

Is the information textual or numeric? Are relative values important?

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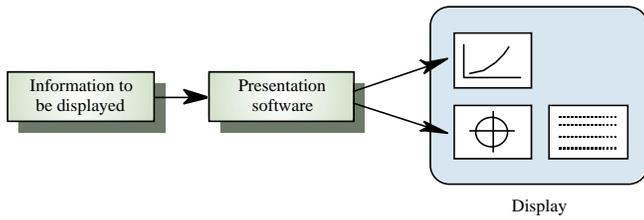
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# Information presentation



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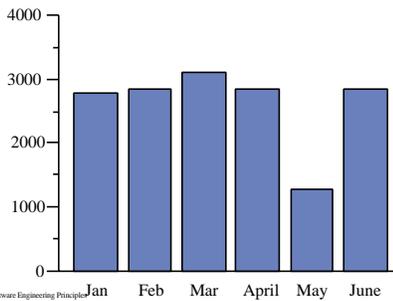
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# Textual and graphical views

Jan	Feb	Mar	April	May	June
2842	2851	3164	2789	1273	2835



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# Analogue vs. digital presentation

## Digital presentation

- Compact - takes up little screen space
- Precise values can be communicated

## Analogue presentation

- Easier to get an 'at a glance' impression of a value
- Possible to show relative values
- Easier to see exceptional data values

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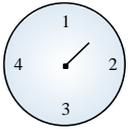
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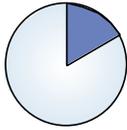
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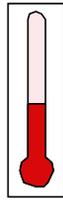
## Dynamic information display



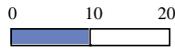
Dial with needle



Pie chart



Thermometer



Horizontal bar

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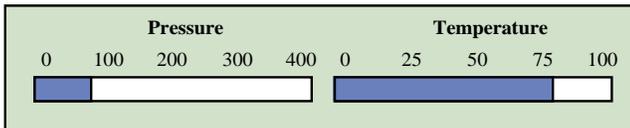
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## Displaying relative values



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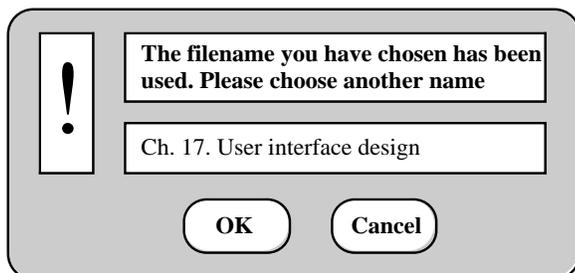
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## Textual highlighting



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## Data visualization

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Concerned with techniques for displaying large amounts of information

Visualization can reveal relationships between entities and trends in the data

Possible data visualizations are:

- Weather information collected from a number of sources
- The state of a telephone network
- A model of a molecule displayed in 3 dimensions

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## Color displays

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Color adds an extra dimension to an interface and can help the user understand complex information structures

Can be used to highlight exceptional events

Common mistakes in the use of color in interface design include:

- The use of color to communicate meaning
- Over-use of color in the display

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## Color use guidelines

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Don't use too many colors

Use color coding to support use tasks

Allow users to control color coding

Design for monochrome then add color

Use color coding consistently

Avoid color pairings which clash

Use color change to show status change

Be aware that color displays are usually lower resolution

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## User guidance

The user guidance system is integrated with the user interface to help users when they need information about the system or when they make some kind of error

User guidance covers:

- System messages, including error messages
- Documentation provided for users
- On-line help

The help and message system may be integrated

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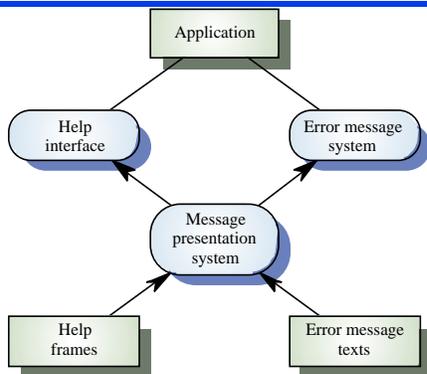
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## Help and message system



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## Error message design

Error message design is critically important. Poor error messages can mean that a user rejects rather than accepts a system

Messages should be polite, concise, consistent and constructive

The background and experience of users should be the determining factor in message design

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## Design factors in message wording

Context	The user guidance system should be aware of what the user is doing and should adjust the output message to the current context.
Experience	As users become familiar with a system they become irritated by long, 'meaningful' messages. However, beginners find it difficult to understand short terse statements of the problem. The user guidance system should provide both types of message and allow the user to control message conciseness.
Skill level	Messages should be tailored to the user's skills as well as their experience. Messages for the different classes of user may be expressed in different ways depending on the terminology which is familiar to the reader.
Style	Messages should be positive rather than negative. They should use the active rather than the passive mode of address. They should never be insulting or try to be funny.
Culture	Wherever possible, the designer of messages should be familiar with the culture of the country where the system is sold. There are distinct cultural differences between Europe, Asia and America. A suitable message for one culture might be unacceptable in another.

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## Nurse input of a name

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## Good and bad error responses

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## Help system design

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Help? means ‘help I want information’  
Help! means “HELP. I’m in trouble”  
Both of these requirements have to be taken into account in help system design  
Different facilities in the help system may be required

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## Help information

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Should not simply be an on-line manual  
Screens or windows don't map well onto paper pages.  
The dynamic characteristics of the display can improve information presentation.  
People are not so good at reading screen as they are text.

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## Help system use

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Multiple entry points should be provided so that the user can get into the help system from different places.  
Some indication of where the user is positioned in the help system is valuable.  
Facilities should be provided to allow the user to navigate and traverse the help system.

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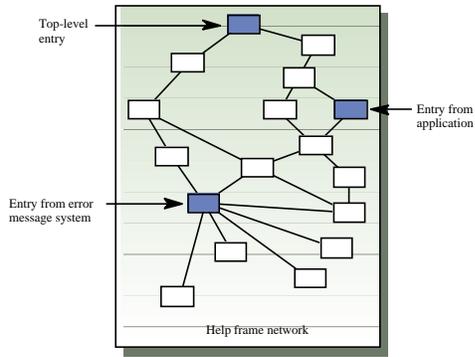
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## Entry points to a help system



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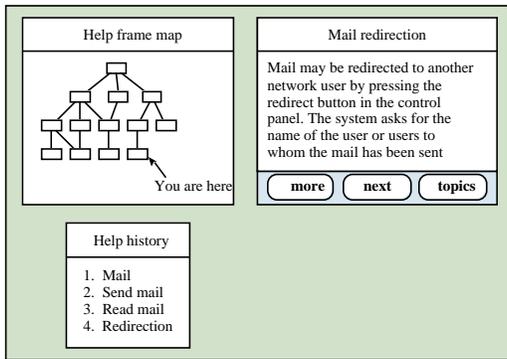
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## Help system windows



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## User documentation

As well as on-line information, paper documentation should be supplied with a system

Documentation should be designed for a range of users from inexperienced to experienced

As well as manuals, other easy-to-use documentation such as a quick reference card may be provided

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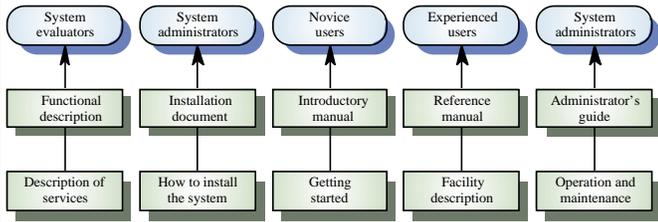
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## User document types



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## Document types

### Functional description

Brief description of what the system can do

### Introductory manual

Presents an informal introduction to the system

### System reference manual

Describes all system facilities in detail

### System installation manual

Describes how to install the system

### System administrator's manual

Describes how to manage the system when it is in use

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## User interface evaluation

Some evaluation of a user interface design should be carried out to assess its suitability

Full scale evaluation is very expensive and impractical for most systems

Ideally, an interface should be evaluated against a usability specification. However, it is rare for such specifications to be produced

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## Usability attributes

Attribute	Description
Learnability	How long does it take a new user to become productive with the system?
Speed of operation	How well does the system response match the user's work practice?
Robustness	How tolerant is the system of user error?
Recoverability	How good is the system at recovering from user errors?
Adaptability	How closely is the system tied to a single model of work?

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## Simple evaluation techniques

Questionnaires for user feedback

Video recording of system use and subsequent tape evaluation.

Instrumentation of code to collect information about facility use and user errors.

The provision of a grip button for on-line user feedback.

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## Key points

Interface design should be user-centered. An interface should be logical and consistent and help users recover from errors

Menu systems are good for casual or occasional system users

Graphical displays should be used to present trends and approximate values. Digital displays when precision is required

Color should be used sparingly and consistently

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## Key points

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Systems should provide on-line help. This should include “help, I’m in trouble” and “help, I want information”

Error messages should be positive rather than negative.

A range of different types of user documents should be provided

Ideally, a user interface should be evaluated against a usability specification

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