L7: Maps and the World Wide Web

10th Feb 2006

Kraak & Ormeling, Cartography – Visualization of Geospatial Data
- chapter 11: Maps and the World Wide Web

Kraak & Brown, Web cartography
- chapter 7: Web map design in practice

Why are web maps unique?

In the past: cartographers were the only ones producing maps

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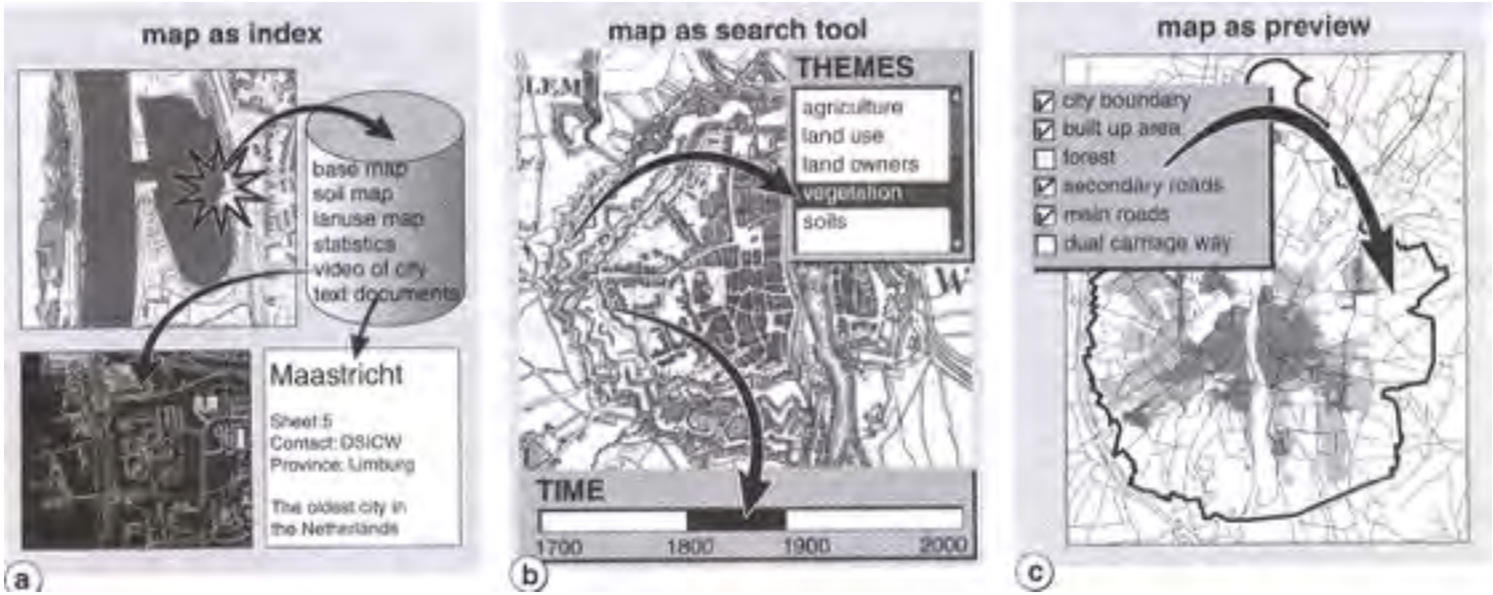
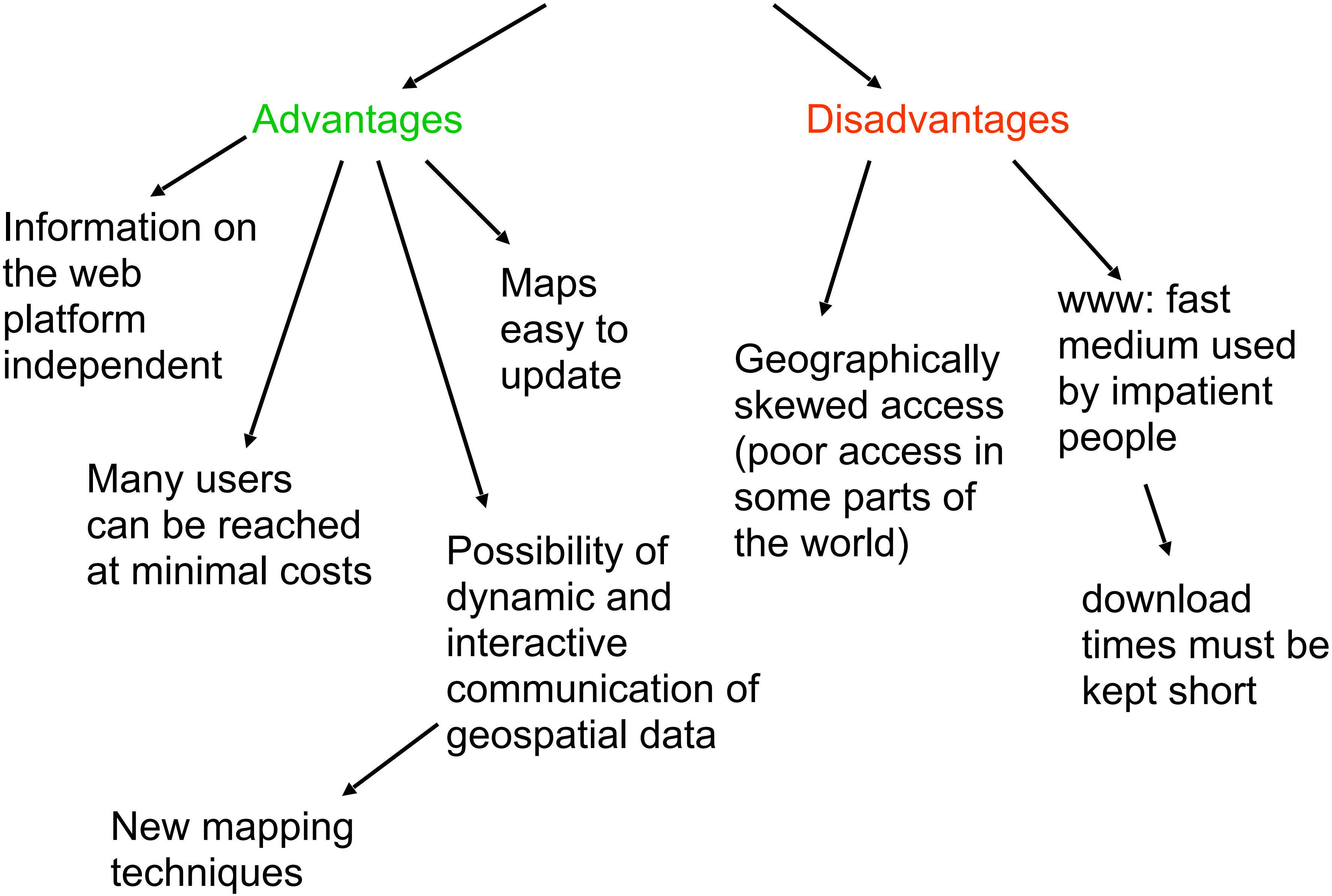
Their skills: guarantee for good & effective maps

Now: everyone can do it and through the www, everyone can access them

Map functions in the www-based geospatial data infrastructure:



Web maps: potential for global dissemination



Advantages

Information on the web platform independent

Many users can be reached at minimal costs

Possibility of dynamic and interactive communication of geospatial data

New mapping techniques

Maps easy to update

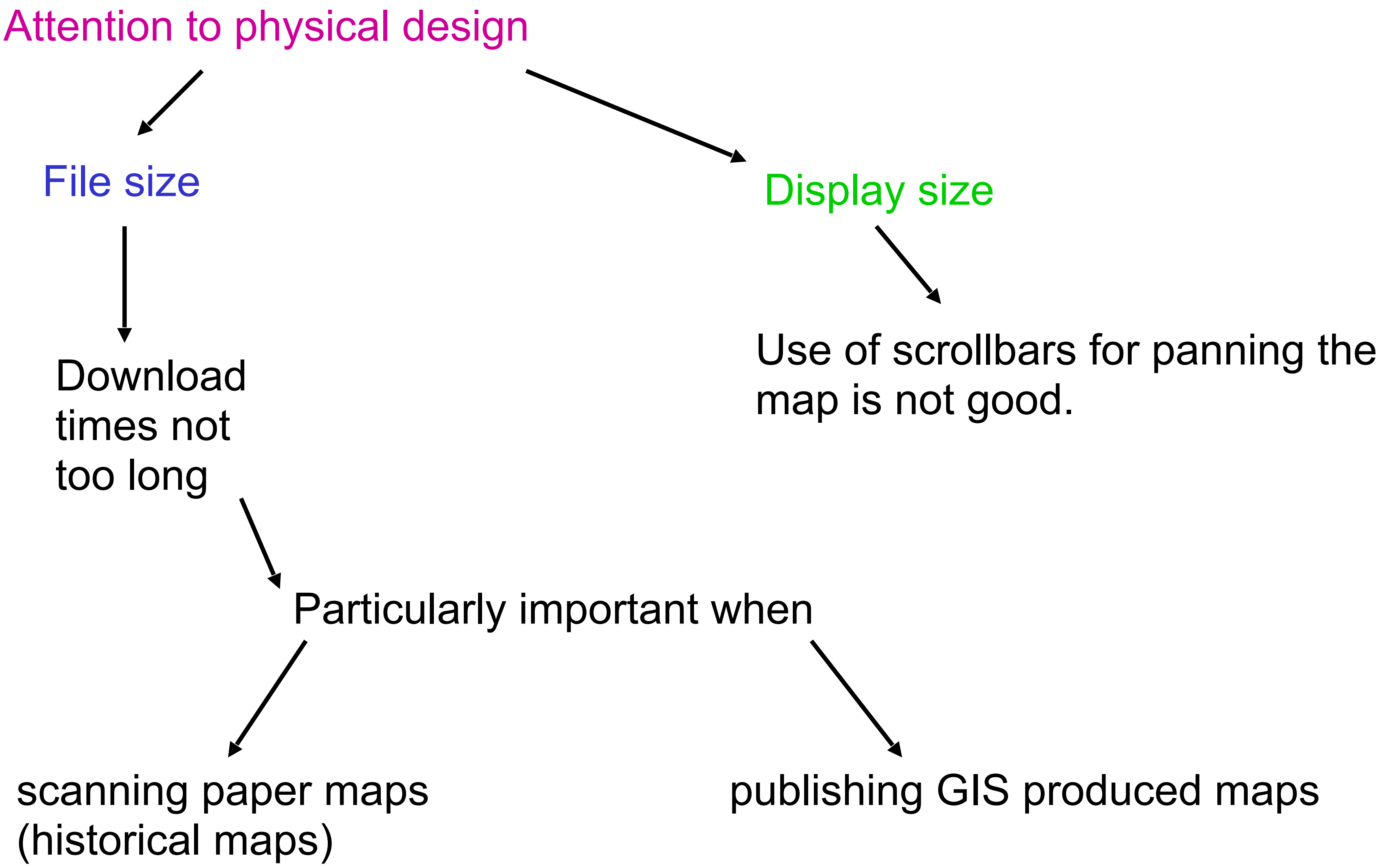
Disadvantages

Geographically skewed access (poor access in some parts of the world)

www: fast medium used by impatient people

download times must be kept short

Web map design



Attention to physical design

File size

Download times not too long

Particularly important when

scanning paper maps (historical maps)

publishing GIS produced maps

Display size

Use of scrollbars for panning the map is not good.

Web maps are ”empty” -> the information is hidden behind the map image and is communicated when clicking or when the mouse is over an object.

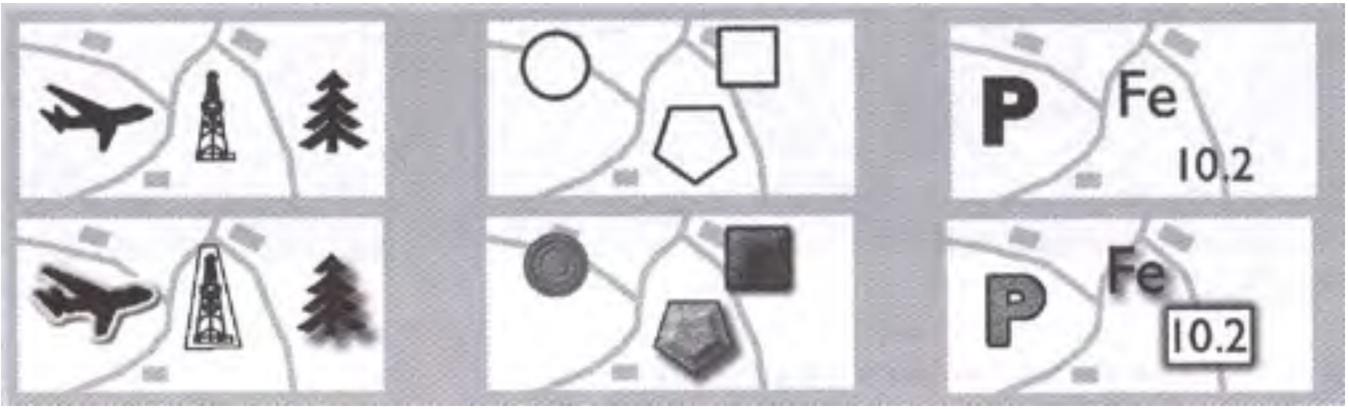
Clickability of symbols

Mouse-over

The appearance of the symbol invites the user to click on it: ”interesting symbols”, 3D symbols, etc.

Symbol changes

Text appears



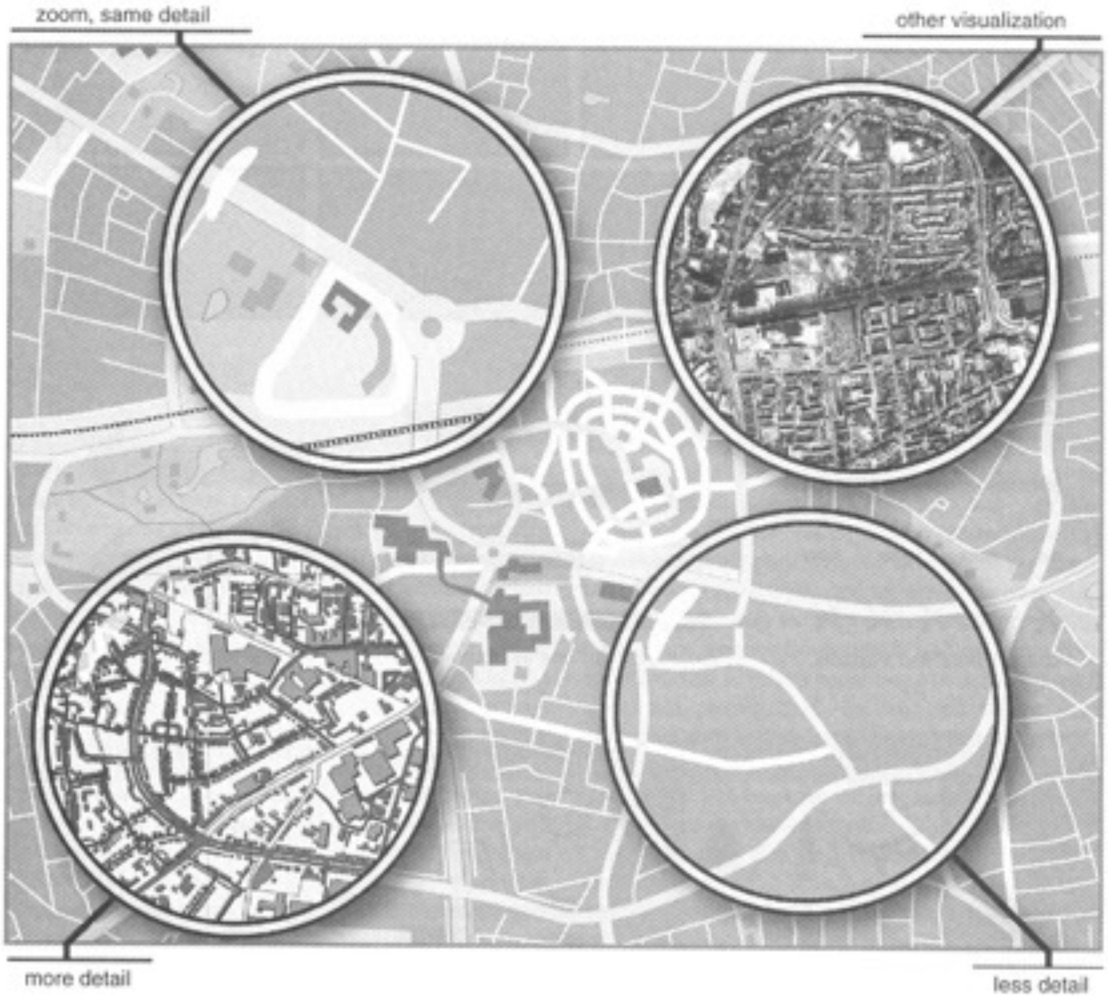
Advantage of ”empty” maps: used for mobile applications (small screens)

Texture filter

Another way to show additional information

A magnifying glass moving over the map:

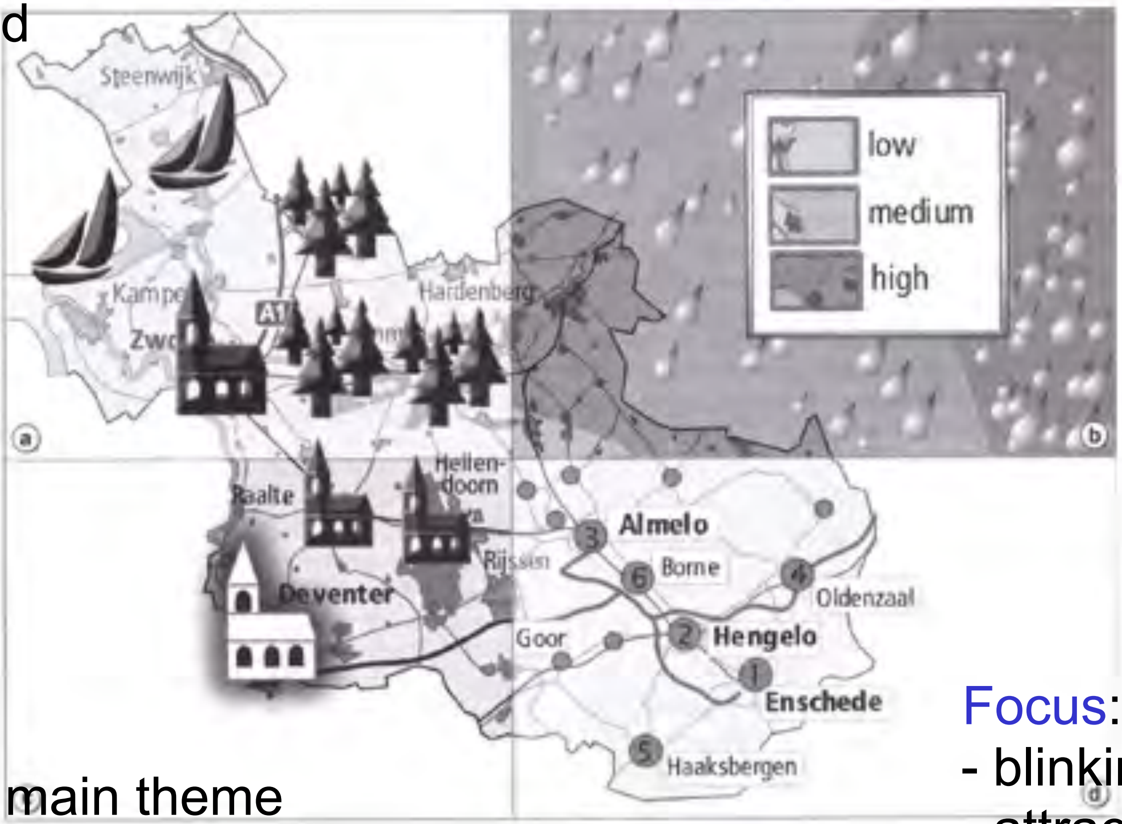
- show more detail: enlargement of the area
- show less detail: concentrate on particular data
- show a satellite imate or a thematic map



New graphical variables – Bertin’s classification extended:

Shadow/shading:
- simulate 3D look
- increase the sense of depth
- increase the contrast between figure & ground

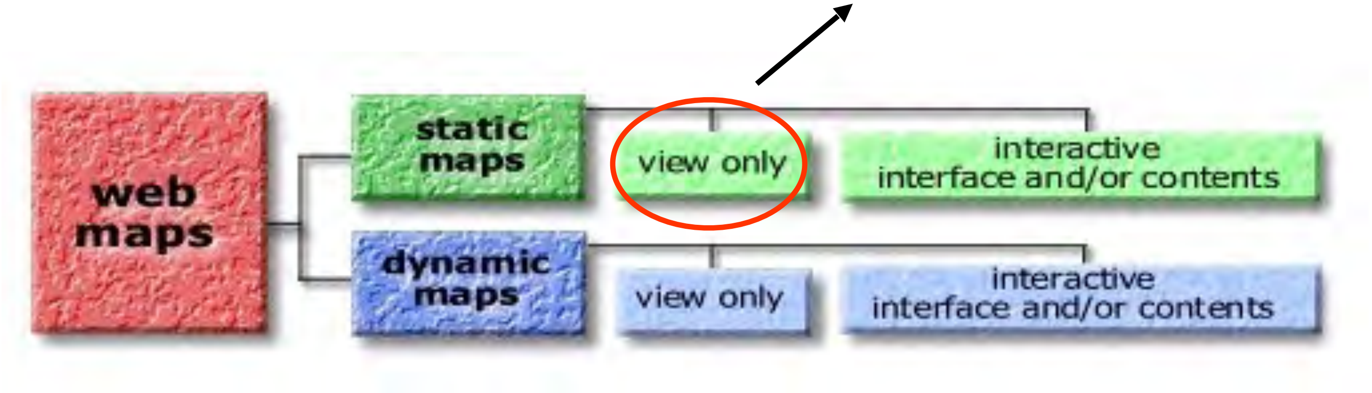
Blur:
- fuzzy appearance
- visualise uncertainty



Transparency:
- fogginess
- enhance the main theme (obscured background info)

Focus:
- blinking
- attracting attention

Classification of web maps

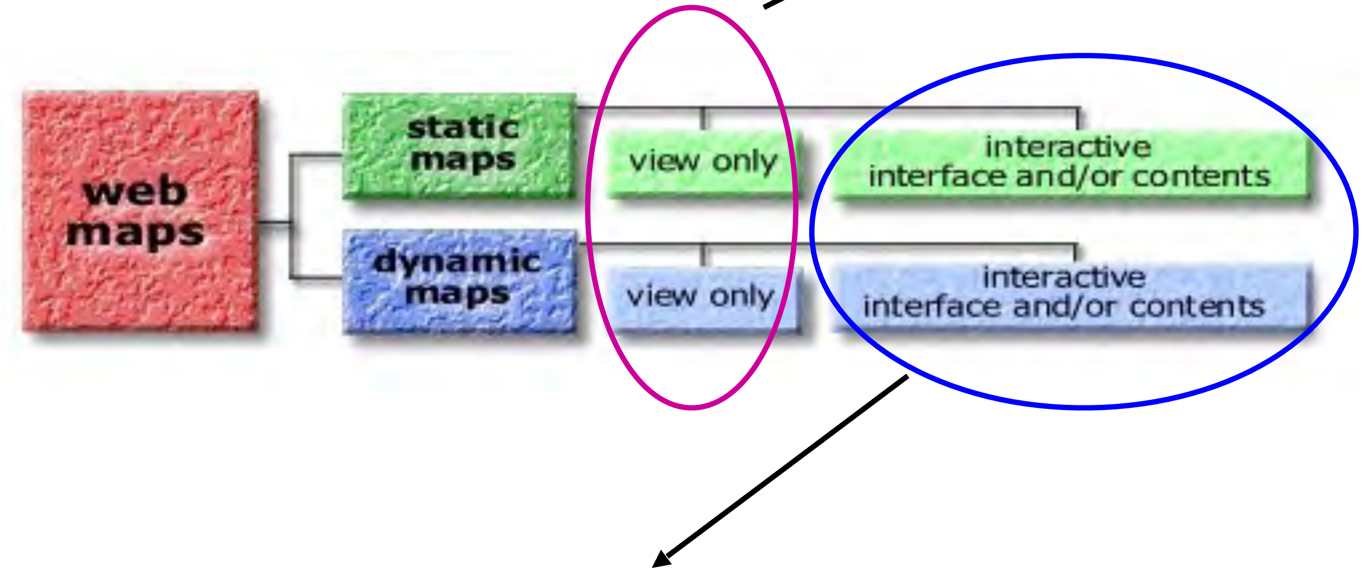

web maps
static maps
view only
interactive interface and/or contents
dynamic maps
view only
interactive interface and/or contents

The most common map type on the web

Factors influencing web map design

Map design depends on the type of the web map:

Map symbols designed in the same way as for traditional maps.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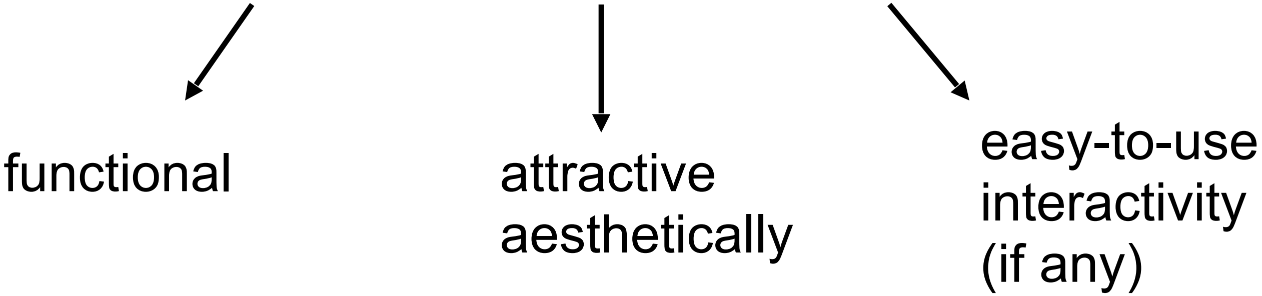
If map-clicking or mouse-over leads to other information – map symbols defined by navigational function (where they lead to) and not to the nature of the mapped data.

Another difference from traditional maps:
users might not be particularly interested in the map (to search for it intentionally), but might have come across it by coincidence when surfing.

A web map has to be **attractive** to keep the surfer’s attention.



functional

attractive aesthetically

easy-to-use interactivity (if any)

Goal for web map design:
combine functionality with a high level of visual attraction and a design that suits the medium.

Visual hierarchy in a web map

Technical limitations:
short download time and/or small screens (mobile devices)

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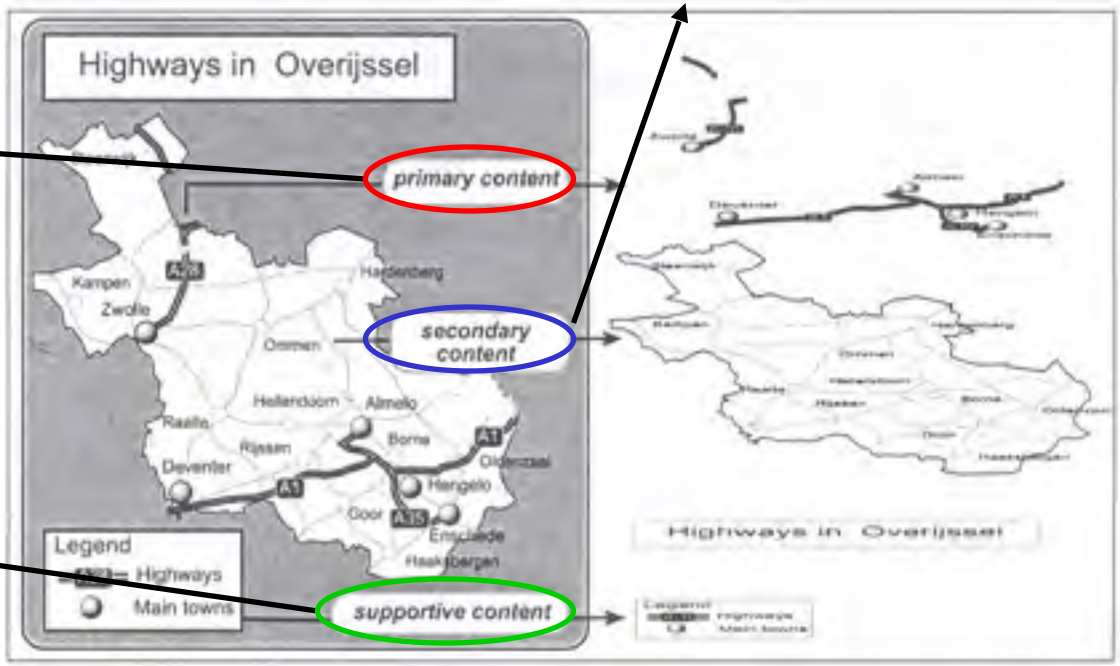
Visual hierarchy especially important: how to convey the important information even with these limitations?

3 content levels:

the main theme of the map: interactive objects

base map (topographic), additional information

marginal information: legend, grid, graphs, etc.

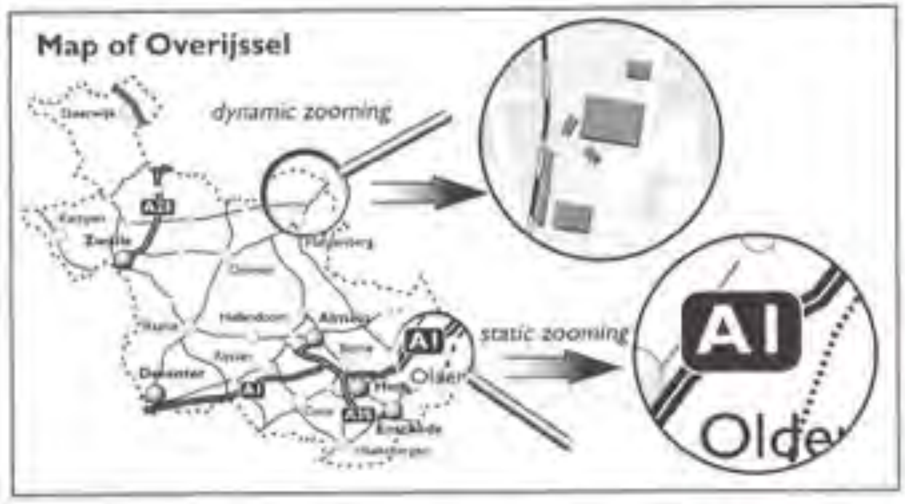


Scale in a web map

Maps on screen: no fixed scale, the map can be zoomed in/out.

Zooming types

Static linear zooming (into one and the same map image)



Static stepped zooming (by changing between several maps of the same area but in different scales)

Dynamic zooming /animated Scaling (direct relation between the scale and how much info is shown: the more zoomed the image the more content is shown – a multiscale database in the background)

Legend in a web map

The web map should be as self-explanatory as possible:
- because of the short viewing time and
- the limited amount of information it can show.

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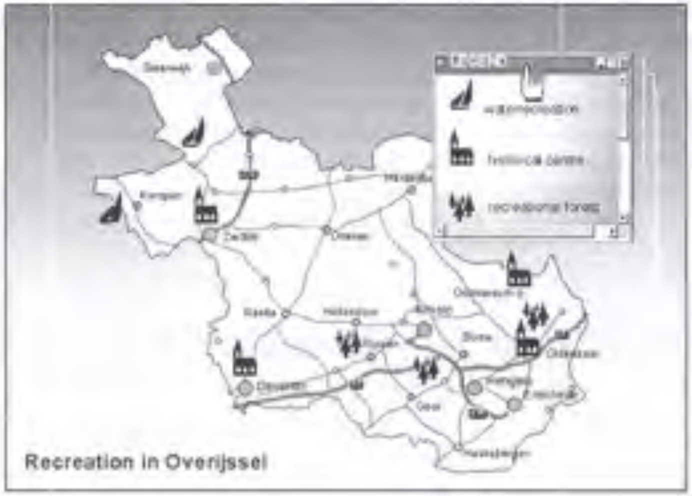
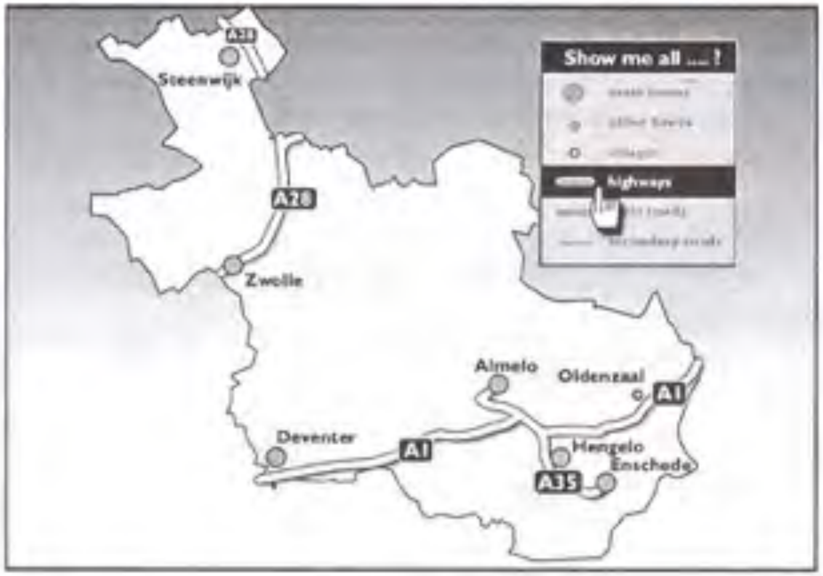
But in practice a legend is still needed. -> A problem: there is often not enough space for it!

Legend types

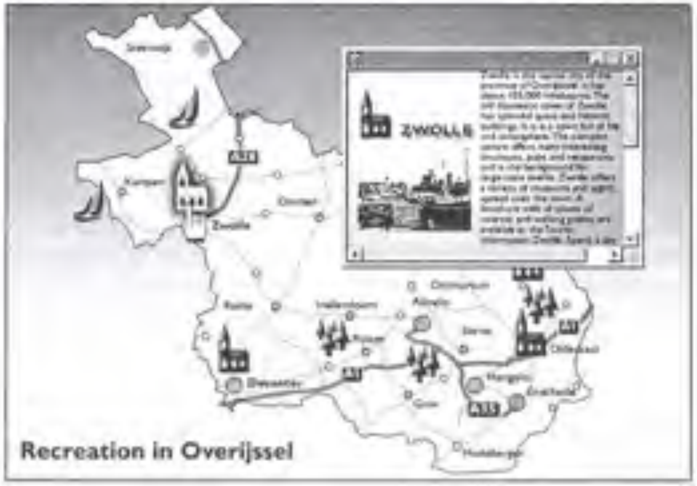
A non-interactive legend
(as on paper maps)



A control-panel legend
(controls information displayed on the map)

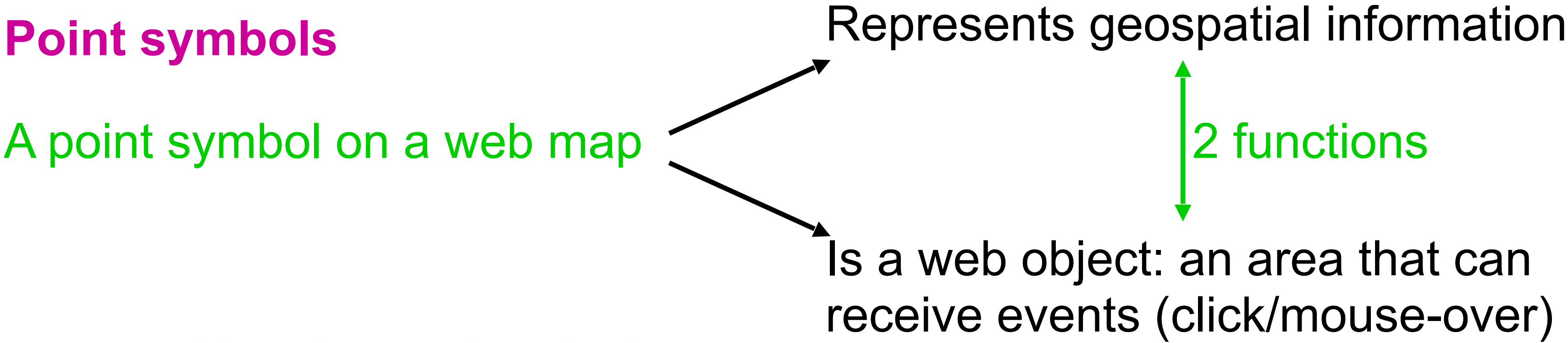


A pop-up legend
(displayed when the user selects an object)



Symbol design for web maps

Point symbols



A point symbol on a web map

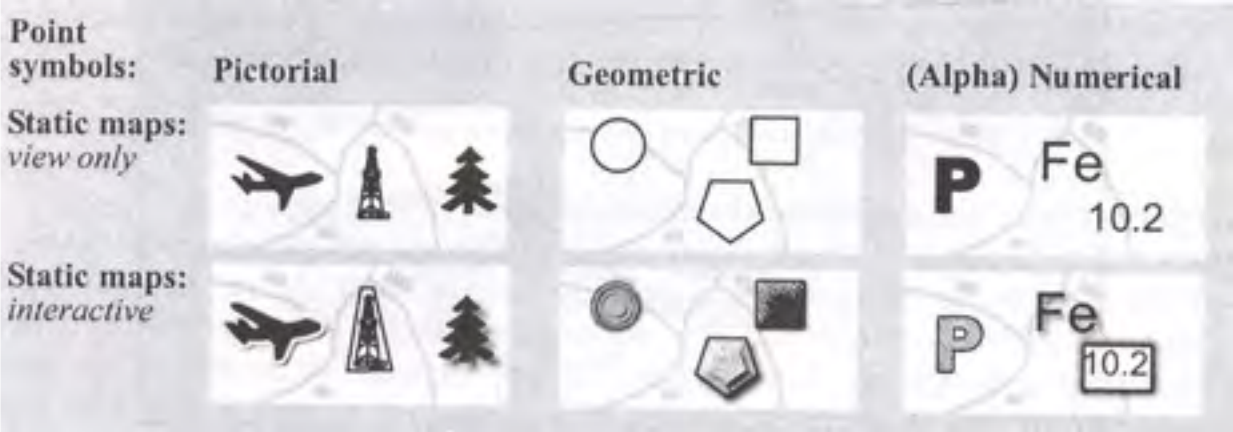
Represents geospatial information

2 functions

Is a web object: an area that can receive events (click/mouse-over)

Issues with point symbol design:

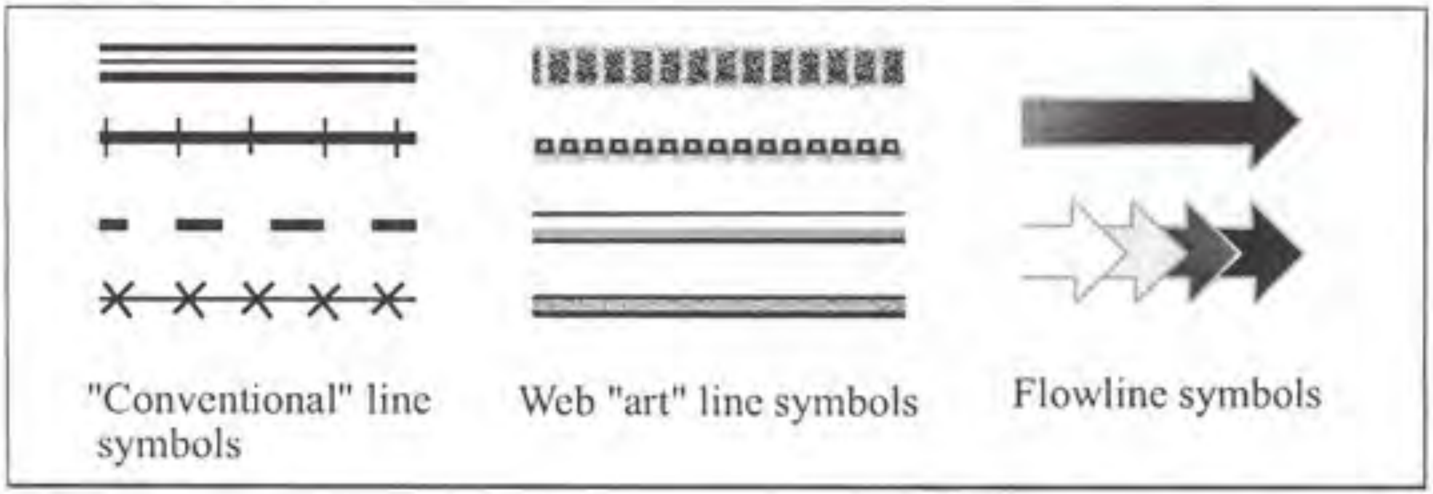
- difficult to make complex point symbols – the low resolution of the screen
- pictorial point symbols often used – easy to understand and clip-art libraries with symbols are available
- geometric symbols need a legend -> problem with available space
- alphanumeric symbols -> need a legend and must be drawn large



Line symbols

Issues with line symbol design:

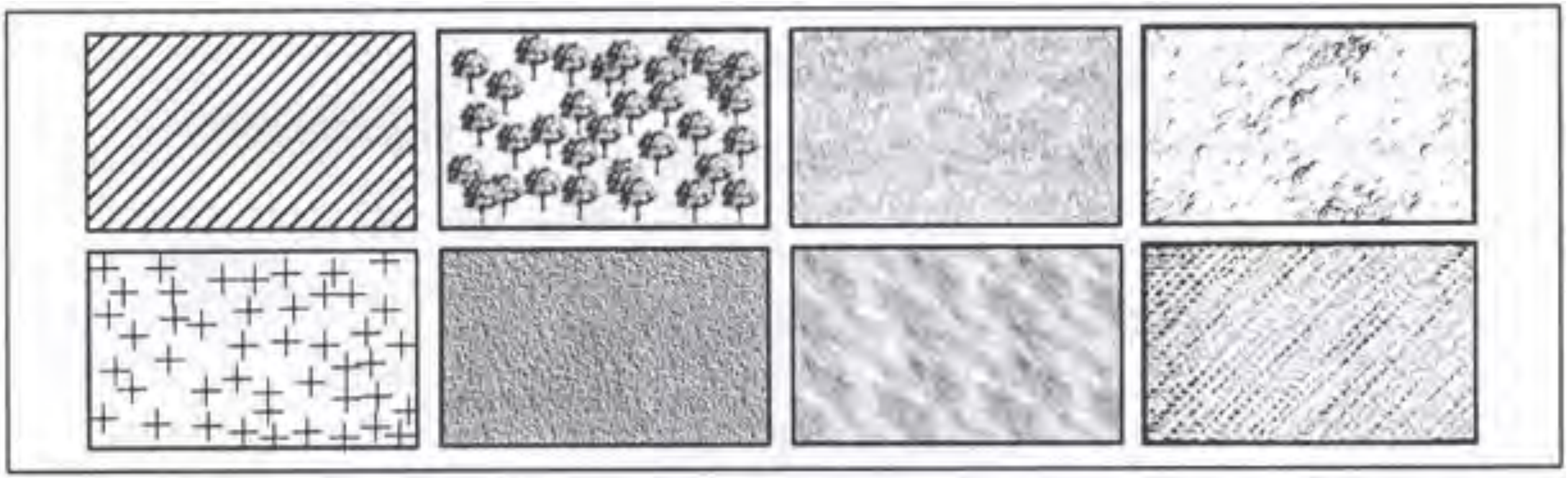
- some graphical variables less suitable for on-screen maps (orientation, texture)
- difficult to handle long & curved lines as interactive web objects (which have to be defined as areas)
- possibility of animation (flow symbols)



Area symbols

Issues with area symbol design:

- can be made more ”interesting” by using other variables, not just colour



- function well as web objects (are large enough for clickability)

Colour for web maps

Issue with colour design:
the sender of the map has NO control over how the image will appear on the user's monitor!

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Assume the minimum configuration and lowest settings.

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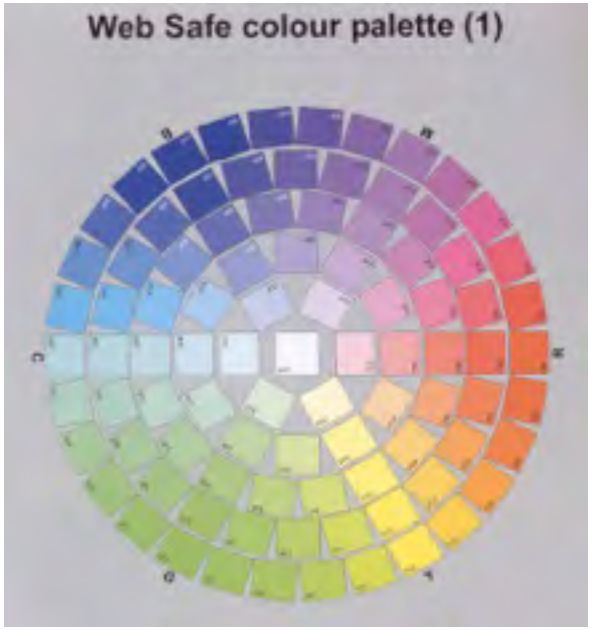
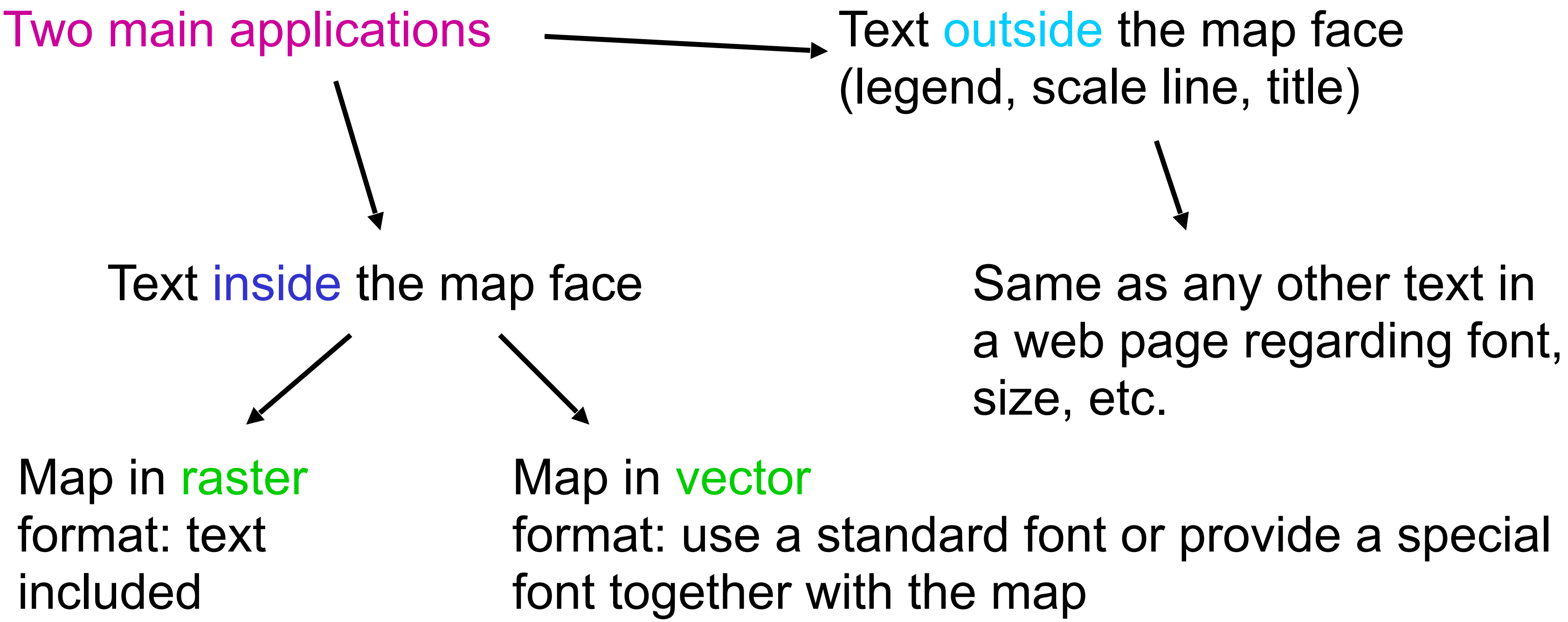
Web Safe Pallete: 216 colours →



Other artistic options:
- blending colours into each other
- fading
- transparency, shadowing
- include photographs as a part of the map

File formats: gif (exact 216 flat colours), jpeg (compression based on colour and intensity – colours may shift during user's ”unpacking”)

Text for web maps



Two main applications

Text outside the map face (legend, scale line, title)

Same as any other text in a web page regarding font, size, etc.

Text inside the map face

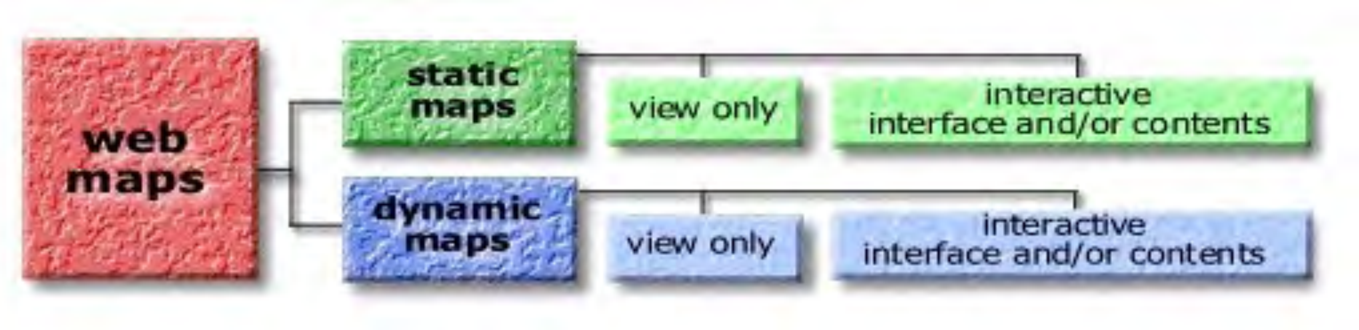
Map in raster format: text included

Map in vector format: use a standard font or provide a special font together with the map

Text readability on screen depends on:
font, font variation, size, orientation, text placement, figure-ground relation, amount of anti-aliasing (removing the jagged lines which result when a non-horizontal/non-vertical edge is depicted in raster format by adding extra coloured pixels along the edge).

Anti-aliased edge
Sharp edge

Classification of web maps – some examples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static maps
view only
interactive interface and/or contents
dynamic maps
view only
interactive interface and/or contents

Static maps – view only

Base: traditional map images

Sources: original cartographic products, scanned and placed on the www.

Historical maps

http://bell.lib.umn.edu/map/OLAUS/indexo.html
Carta Marina, map of Scandinavia by Olaus Magnus, 1539

http://histlab.itc.edu.stockholm.se/arkivet/kartor/kartor.shtm
Historical maps of Stockholm, Historiska laboratoriet, 1625 – 1885

Other examples

http://kartoweb.itc.nl/webcartography/webmaps/static/s-view.htm
Examples by M. J. Kraak

Static maps – interactive

Interaction: zooming, panning, or hyperlinking to other information - clickable maps (map = an interface to geospatial data).

Hyperlinking to other information

http://www.burger.si/SLOIndex.htm
Interactive map of Slovenia
Slovenia landmarks

Interactive zooming

http://www.hitta.se/
Swedish city and country maps

Dynamic maps – view only

Dynamic maps: show change in one or more of the geospatial data's components.

http://kartoweb.itc.nl/webcartography/webmaps/dynamic/dv-example1.htm
4 examples by M. J. Kraak

Dynamic maps – interactive

Interaction with the map: play, backward, forward, etc.

http://www.smhi.se/ -> Prognoser&Observationer -> Molnighet
Swedish weather forecast, interactive changing of the satellite image

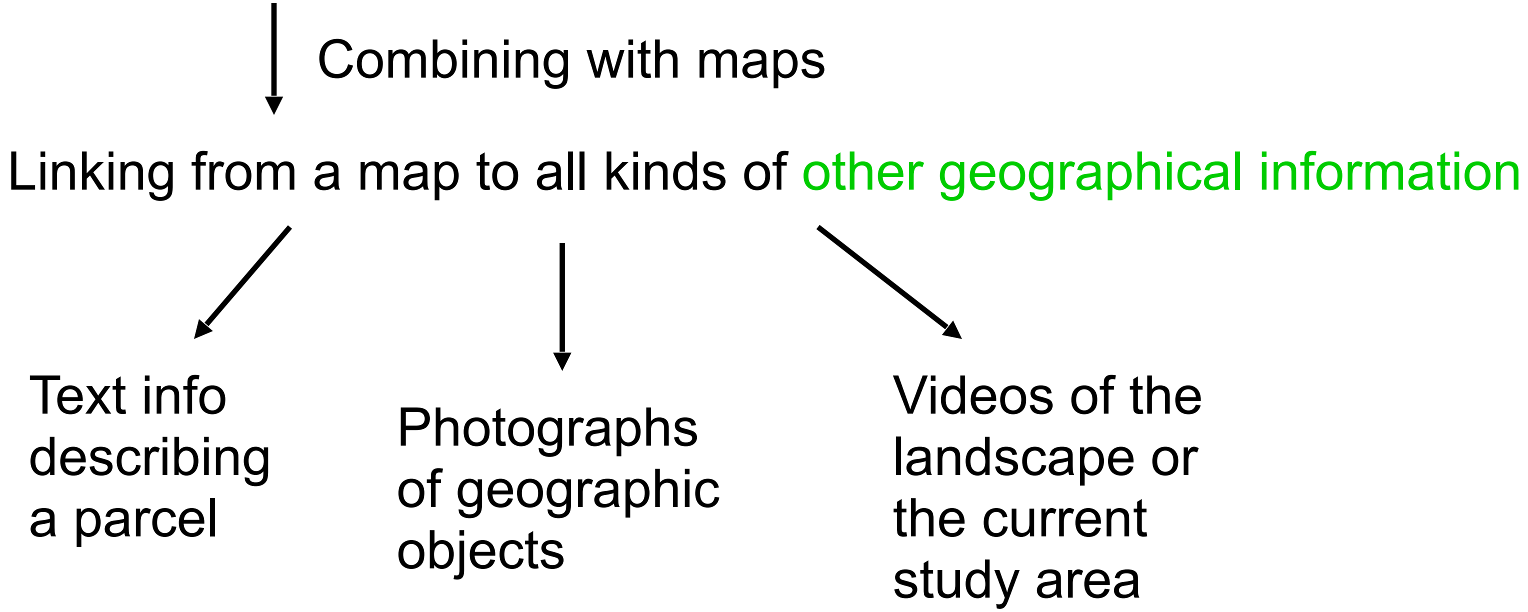
http://www.ssec.wisc.edu/data/geo/met7/
weather over Europe (8 image animation of MET-7 data)

http://kartoweb.itc.nl/webcartography/webmaps/dynamic/di-example3.htm
a flyby over a landscape 3D model

Web maps and multimedia

www – an ideal platform to combine maps + multimedia

Multimedia: interactive integration of sound, animations, text and images (still images and videos).



Combining with maps

Linking from a map to all kinds of other geographical information

Text info describing a parcel

Photographs of geographic objects

Videos of the landscape or the current study area

Multimedia and geovisualisation:

- http://www-2.cs.cmu.edu/Groups/sage/sageshk.html
  Sound – Napoleon’s 1812 Russia campaign

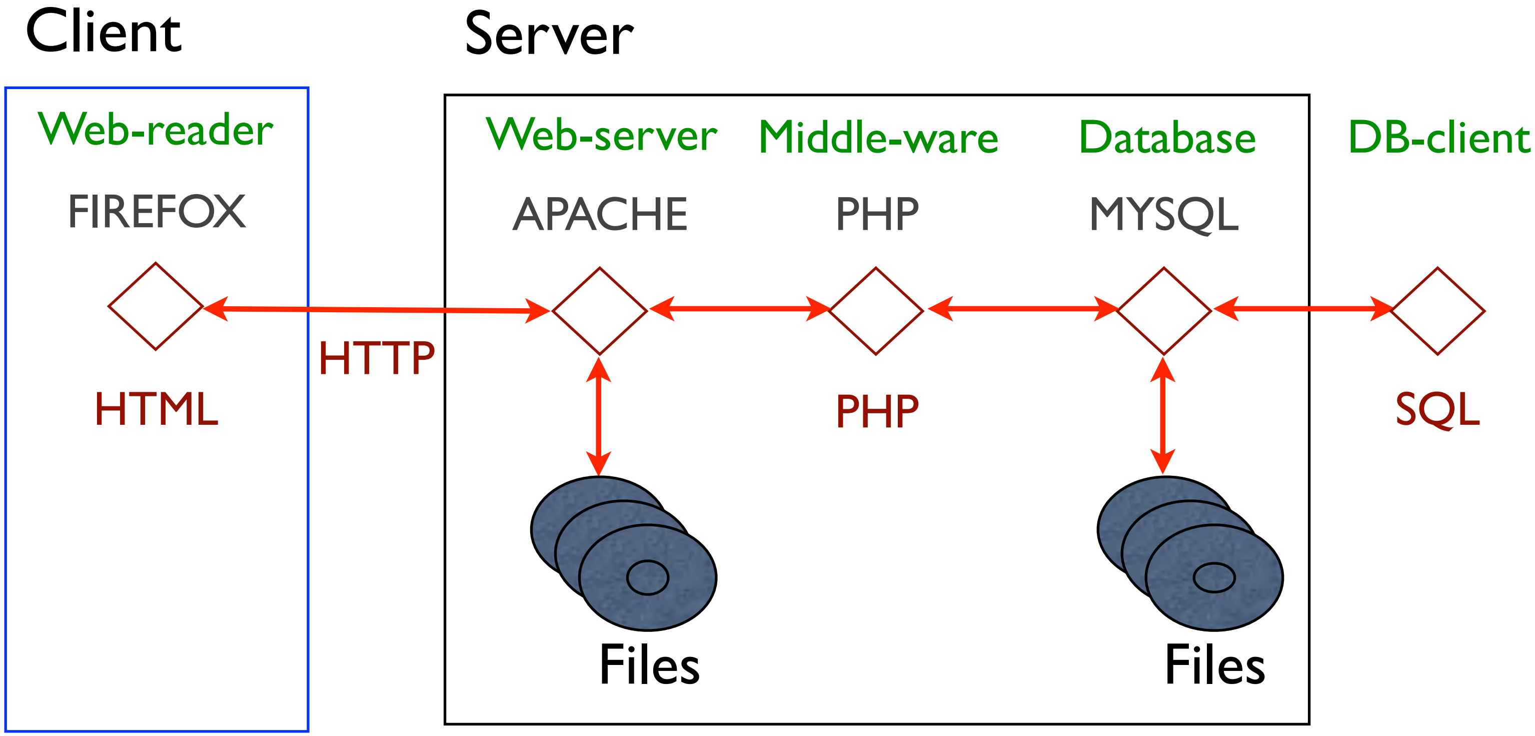
- http://www.geni.org/globalenergy/multimedia/animations/visibleearth.nasa.gov/rotatingearth/ev11664_rotate_320.mpg.mpeg
  Animation – rotating Earth

Web-mapping

Alternatives for delivering maps over the internet

Map server (e.g. ARCIMS)
Virtual globe scripting (Google Earth, Nasa Worldwind, Microsoft Virtual Earth
Google maps
Script langauges (e.g. Javascript)
Flash actionscript
html pages

Web-mapping

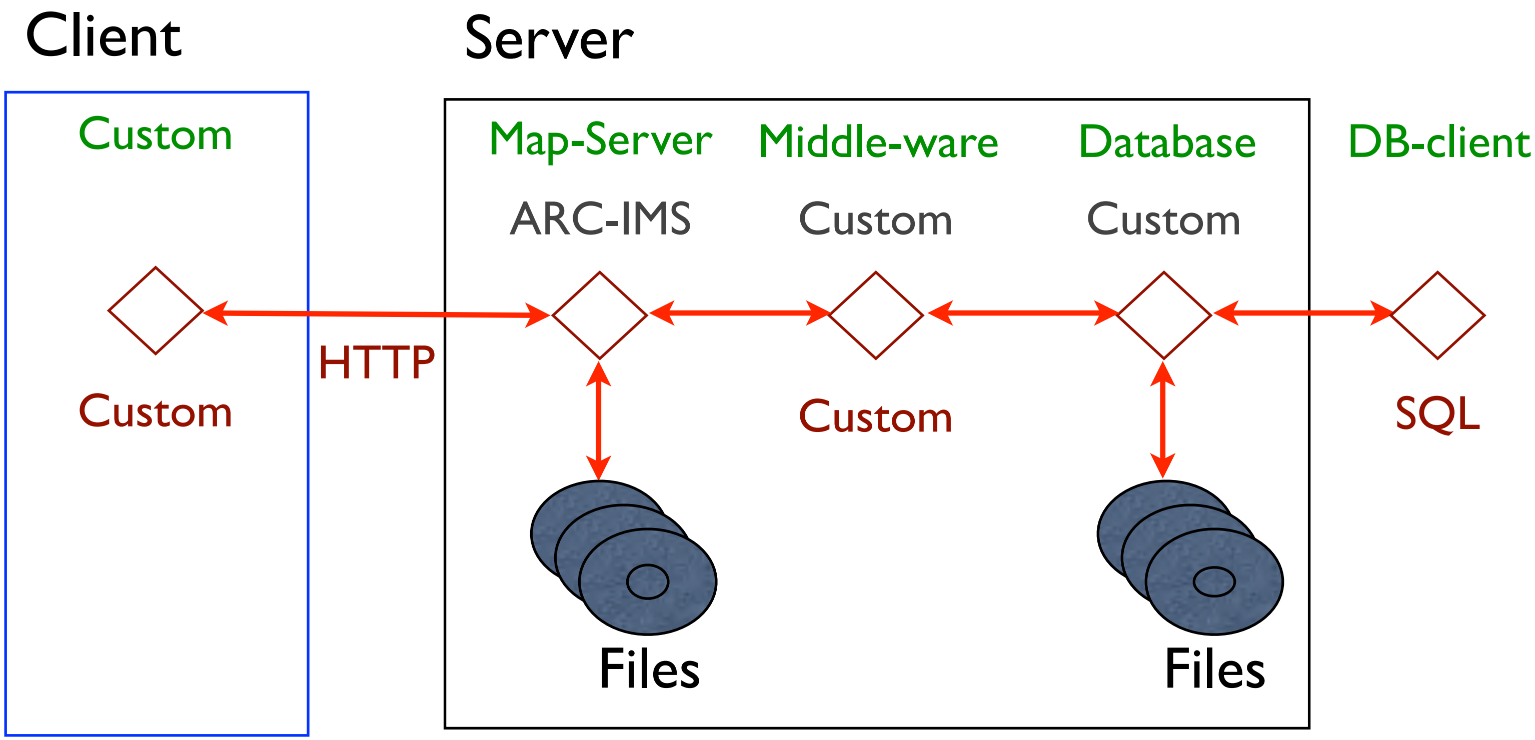

Client
Server
Web-reader
FIREFOX
HTML
HTTP
Web-server
APACHE
Files
Middle-ware
PHP
PHP
Database
MYSQL
Files
DB-client
SQL

Web-mapping

Map server (e.g. ARCIMS)

A mapserver is a server based map production solution, often linked to a GIS software vendor/ product (not only ESRI).
Advantage: Advanced inbuilt mapping functions
Disadvantage: Costly and demands fast internet connection

Web-mapping with custom map server



Client

Server

Custom

Map-Server

Middle-ware

Database

DB-client

ARC-IMS

Custom

Custom

HTTP

Custom

Custom

SQL

Web-mapping

Map server (e.g. ARCIMS)

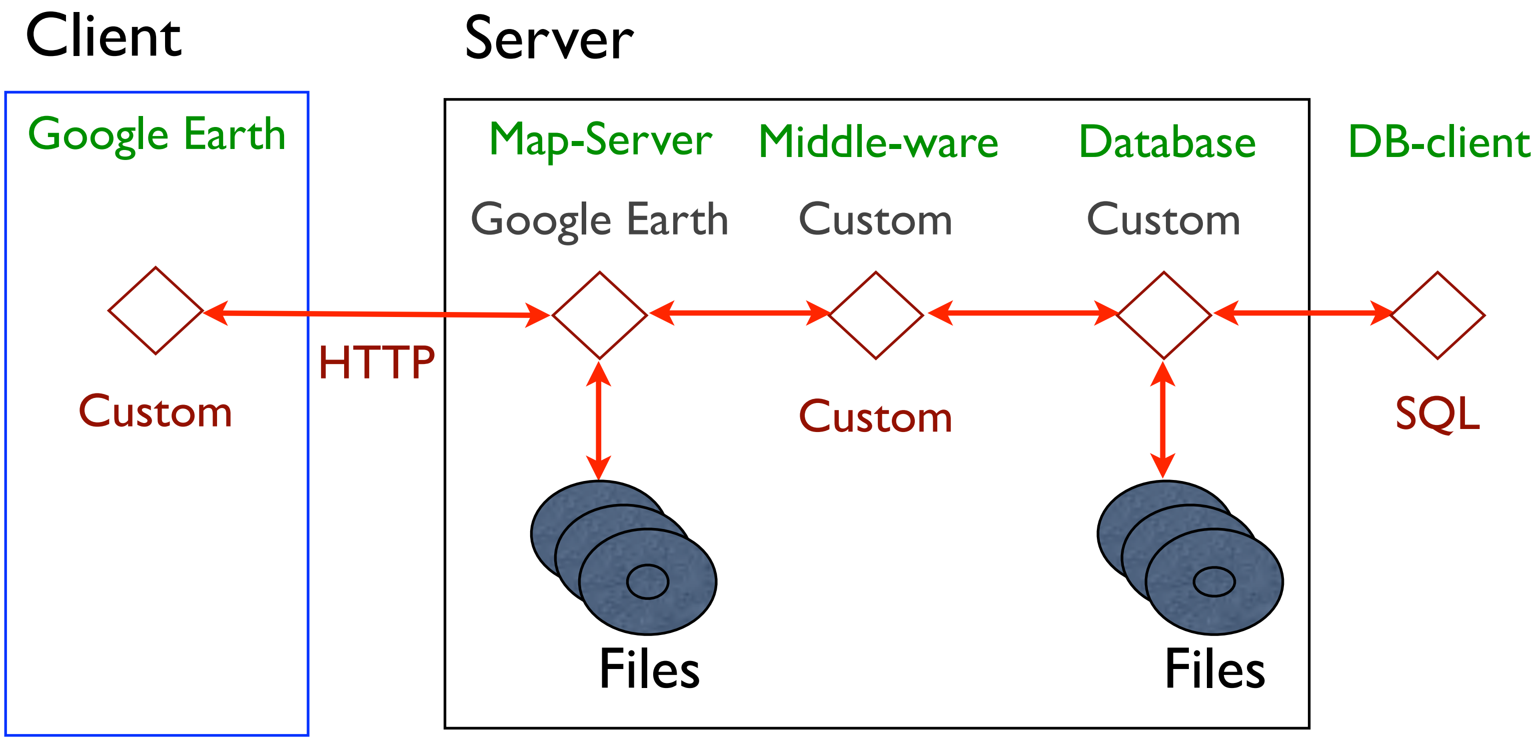
The course in web-programming focuses on using web-server for producing internet maps.

Web-mapping

Virtual globe scripting

The virtual globes are based on scripting and uses server side applications for delivering maps to the client
Advantage: Background images and maps included, flexible, can display in 3D
Disadvantage: Difficult to write, demands fast internet connection, unless you load your data in a local cache.

Web-mapping with custom map server



Web-mapping

Virtual globe scripting

Example: Google Earth.
Google Earth uses its own extended markup language called Keyhole Markup Language (KML).
If you are familiar with xml you should have no problem in scripting KML.

Virtual globe scripting

Example: Google Earth.

```
<?xml version='1.0' encoding='UTF-8'?><kml xmlns='http://earth.google.com/kml/2.1'>
<Document>
 <Placemark>
   <name>Aerial photo</name>
   <description><![CDATA[theme:aerial<br>date: 2006-10-28<br>time: 08:00:00<br>explorer:
     thomasg<br>event: <a href='http://mapjourney.net/user/se/thomasg/2/1/1.php'>Aerial
     photo</a>]]></description>
   <Style>
    <LabelStyle>
     <color>B0FFFFFF</color>
     <scale>1.5555555555556</scale>
    </LabelStyle>
    <IconStyle>
     <color>70005AFF</color>
     <scale>1.28</scale>
     <Icon><href>root://icons/palette-4.png</href><x>192</x><y>96</y><w>32</w><h>32</h></Icon>
    </IconStyle>
   </Style>
   <Point>
    <altitudeMode>absolute</altitudeMode>
    <coordinates>23.44851645,19.96494519,991.18000</coordinates>
   </Point>
  </Placemark>
  <Placemark><name>…
```

Virtual globe scripting

KML structure:

http://code.google.com/apis/kml/documentation/kml_tags_21.html

http://www.tiles2kml.com/

Web-mapping

Google maps

Google maps are based on scripting and uses server side applications for delivering maps to the client

Advantage: Flexible, can be included in any web-page

Disadvantage: Difficult to write, demands fast internet connection, the url must have an API from Google

Google maps

Google maps are interfaced using javascript, and to run a Google map on your own web-page you must have an API under license from Google.

http://www.google.com/apis/maps/

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
……
<script src="http://maps.google.com/maps?file=api&amp;v=2&amp;
  key=ABQIAAAAuQiaSGUEuilt34UFoYXwJxSbVgUtgl0plsdq1IjMwrVMLz11WRTKoKQkMD-O9eT7iVqG2IxKUNGatQ"
     type="text/javascript"></script>
   <script type="text/javascript">
   //<![CDATA[
   var lat = 0;
   var long = 0;
    var zoom =13;
   function loadmap(lat,long,zoom) {
     if (GBrowserIsCompatible()) {
       var map = new GMap2(document.getElementById("map-container"));
       map.addControl(new GSmallMapControl());
       map.addControl(new GMapTypeControl());
       map.setCenter(new GLatLng(lat,long),zoom);
       GEvent.addListener(map, "click", function(overlay, point) {
         if (overlay) {
           map.removeOverlay(overlay);
         } else {
           map.clearOverlays();
           map.addOverlay(new GMarker(point));
           var lat = point.lat();
           var long = point.lng();
           var ptlong = document.getElementById('ptlong');
                      var ptlat = document.getElementById('ptlat');
           ptlong.value = long;
                      ptlat.value = lat;
         }
       });
     }
   }
   //]]>
   </script>
</head>
```

http://www.mapjourney.net/mymj2/mjregwptest12.php

Web-mapping

Flash actionscript

Standard script language interpreted by most browsers, with high interaction potential
Advantage: Flexible, can be included in any web-page, can be used on local machines without internet connection, seamless rendering
Disadvantage: Difficult to write, all map data must be produced (licensed if necessary)

Flash actionscript

```
var radar_offset:Number=0;
var currentid:Number=0;
var topid:Number=1;
var hotspots:Array=new Array;
// Create container movieclip
var vr:MovieClip = _root.createEmptyMovieClip("vr", 1);
// prevent access to "real"
rootvr._lockroot=true;
function clearHotspots() {            var mc:MovieClip;
        var i:Number;
        for (i=0;i<hotspots.length;i++) {
                mc=hotspots[i];
                mc.removeMovieClip();
        }
        hotspots=new Array();}function loadPanorama(id:Number) {
        // Create a Movieclip loader
        var myLoader = new MovieClipLoader();
        var myListener = new Object();
                // remove old Hotspots
        clearHotspots();
        myListener.onLoadStart = function () {
                var filename:String;
        // Set the dimentions and position of the pano
                vr.window_width=480;
        vr.window_height=380;
```

Flash actionscript

Example:

Free mapmaker that produces maps as flash actionscripts are available at: http://www.zoomify.com/

http://www.mapjourney.com/sahel/zoom/zoom_001__z.htm

Web-mapping

Html pages with javascript

Can be used with most browsers
Advantage: Can be used on local machines without internet connection
Disadvantage: Difficult to write, slower reload on zooming and panning (new html pages must be opened), all map data must be produced (licensed if necessary)

Web-mapping

Html pages with javascript

Example: World temperature change
http://localhost/mj2mymj/mj2climate.php

Web-mapping

Html pages (no or little scripting)

Can be used with all browsers

Advantage: Can be used on local machines without internet connection, easy to write simple applications

Disadvantage: Low interactivity, with many maps it takes many html pages, slower reload on zooming and panning (new html pages must be opened), all map data must be produced (licensed if necessary)

HTML pages

Html pages: example

```
<MAP NAME="logomap">
<AREA SHAPE=POLYGON HREF="http://www.xxx" COORDS=95,47,94,47,96,44,95,47 title="Uganda">
 <AREA SHAPE=POLYGON HREF="http://www.yyy" COORDS=68,29,86,29,87,44,67,44,68,29 title="Sahel start page">
 <AREA SHAPE=POLYGON HREF="http://www.zzz" COORDS=38,14,38,3,71,2,71,14,38,14 title="Sahel start page">
</MAP>
```

http://www.mapjourney.com/sahel/zoom/imap54/m10000.htm

Web-mapping

Resources at ESRI for web-mapping using ArcGIS

http://arcscripts.esri.com/