

Software Cost Estimation

SLOC-based Models and the
Function Points Model

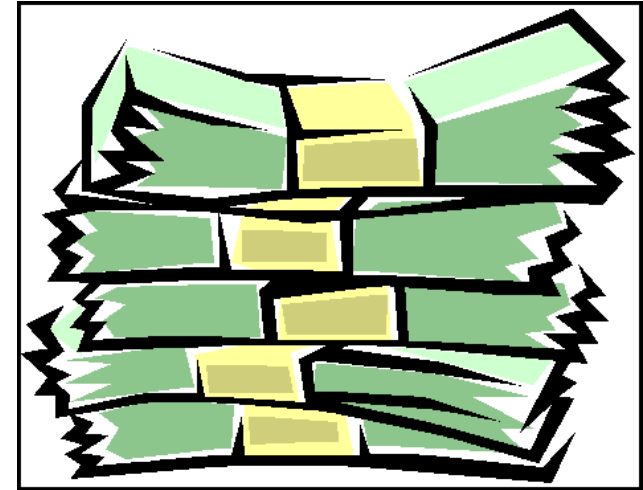


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For SWE4103

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Outline

- Introduction
- SLOC-based Approach
- Function Points Approach
- Conclusions



Introduction

- Ad-hoc models initially used
- Need for formal estimation model
- Lines of code easily understood metric
- 1970 – SLIM (Putnam)
- 1979 – Function Points (Albrecht)
- 1981 – COCOMO (Boehm)

Intro

SLOC

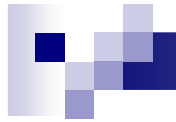
Function Points

Conclusion

Wagerline.com

- Total Estimated Hours = 76
- $76 \times \$40 \text{ per hour} = \3040

The screenshot shows the Wagerline.com website in a Mozilla Firefox browser window. The browser title is "Wagerline.com - FREE Real-time Scores, Odds, & Contests for All Major Sports - Mozilla Firefox". The website has a navigation bar with links for HOME, COVERS, COVERS EXPERTS, SPORTSBOOKS, and POKER ROOMS. A prominent banner advertises a "10% Bonus on Referrals!" and a "10% Sign Up Bonus!" with a "GO! sportsbook.com" button. Below the banner, the website logo "wagerline.com" is displayed along with the tagline "SCORES, ODDS, & CONTESTS FOR ALL MAJOR SPORTS!". A navigation menu includes "Live Scores & Odds", "Contests", "Create/Join a Contest", "Survivor", "My Account", "Become a Member", and "Free Picks". The main content area features a "bodog.com" logo and a news article titled "Seahawks release Jerry Rice" with a sub-headline "Kirkland, WA (Sports Network) - The Seattle Seahawks released future Hall of Fame wide receiver Jerry Rice on Friday." and a "More..." link. To the right, there is a "bodog.com | wagerline.com" section for a "\$2000 FREEROLL TOURNAMENT" with details about a \$2000 freeroll tournament on March 9th, 2005. A "Sign Me Up!" button is visible. The footer contains a URL: "http://ad.doubleclick.net/click;h=v3|322a|14|d8|*|g;13580205;0-0;0;10826607;1400-260|150;8750664|8768560|2;;~sscscs=?http://oascentral.wagerline.com/R...".



Intro

SLOC

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Wagerline.com

| Function | Hours |
|------------------------------------------------------------------------|--------------|
| Web site design | 10 |
| Database model and creation | 10 |
| External data feed integration and creation of individual sports pages | 10 |
| Install, setup, customize phpBB forums | 4 |
| Home, About Us, Contact Us pages | 4 |
| Leader board for each sport | 6 |
| Display user's pending picks | 4 |
| Modify user profile | 4 |
| Display user profile | 4 |
| User registration and login | 4 |
| User-defined Pools | 16 |
| Create a new pool (4 hrs) | |
| Display pool leaders (4 hrs) | |
| Make picks for a pool (4 hrs) | |
| Display all public pools (4 hrs) | |

How do you estimate SLOC?

- Experience
- Previous system size
- Existing system size
- Breaking system into pieces

How do you estimate SLOC?

- For each piece estimate
 - Smallest possible SLOC - a
 - Most likely SLOC - m
 - Largest possible SLOC - b

From “Example of an Early Sizing, Cost and Schedule Estimate for an Application Software System” by L. H. Putnam

How do you estimate SLOC?

- Expected SLOC for each piece

$$E_i = \frac{a + 4m + b}{6}$$

- Total Expected SLOC

$$E = \sum E_i$$

From “Example of an Early Sizing, Cost and Schedule Estimate for an Application Software System” by L. H. Putnam

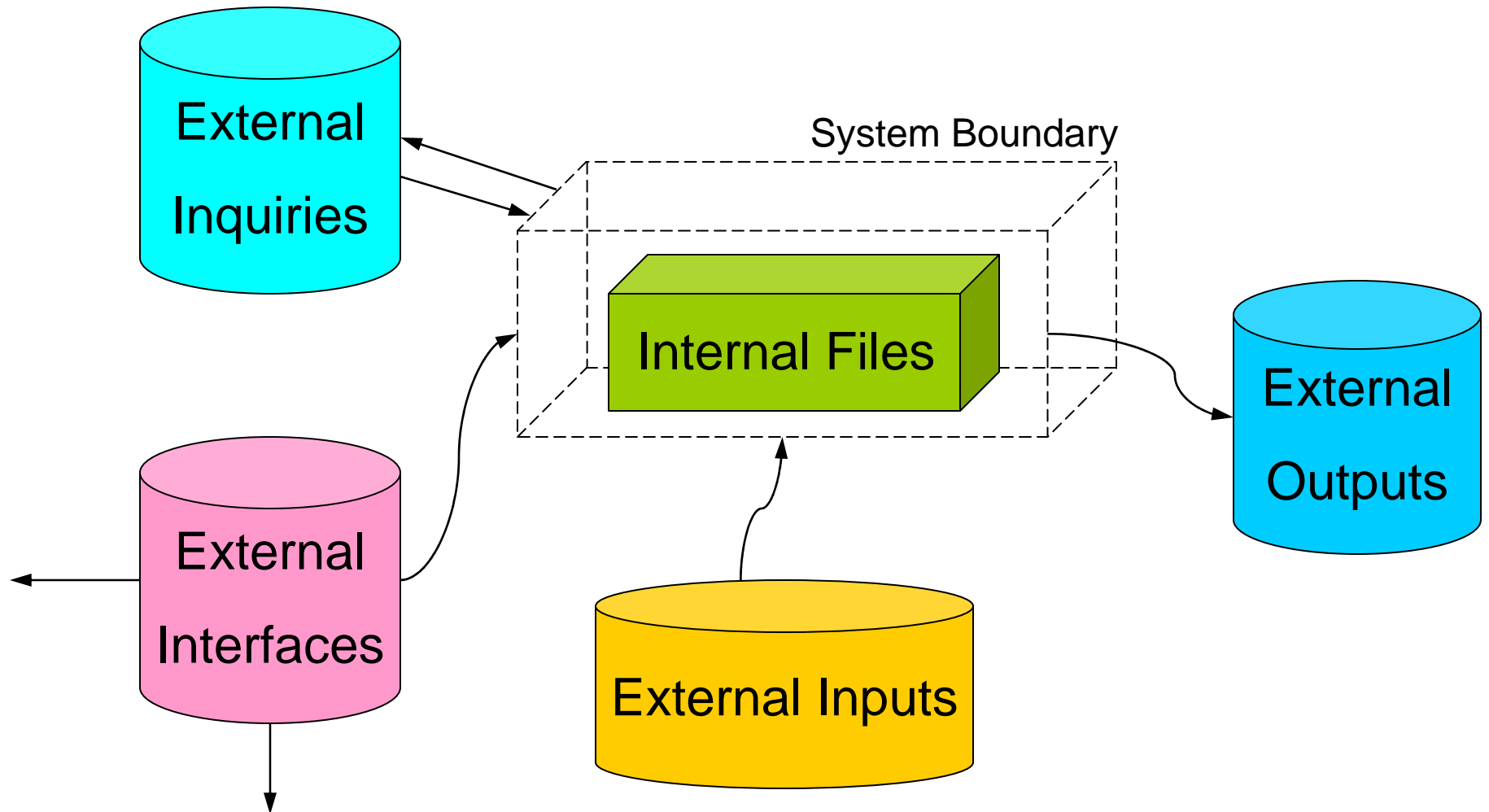
SLOC Estimate Example

| | Smallest | Most Likely | Largest |
|------------------------------|----------|-------------|---------|
| Display user's pending picks | 200 | 300 | 500 |
| Modify user profile | 100 | 150 | 250 |
| Display user profile | 250 | 300 | 450 |
| User registration and login | 200 | 220 | 250 |

What are function points?

- Functions of a software system
- 5 Categories
 - External Input
 - External Output
 - Internal File
 - External Interface
 - External Inquiry

What are function points?



Unadjusted Function Points (UFP)

| | Low | Avg. | High |
|--------------------|---------|----------|----------|
| External Input | ___ x 3 | ___ x 4 | ___ x 6 |
| External Output | ___ x 4 | ___ x 5 | ___ x 7 |
| Internal File | ___ x 7 | ___ x 10 | ___ x 15 |
| External Interface | ___ x 5 | ___ x 7 | ___ x 10 |
| External Inquiry | ___ x 3 | ___ x 4 | ___ x 6 |

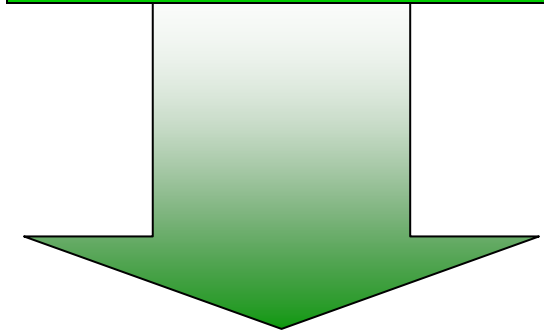
$$UFP = \sum_{i=1}^3 \sum_{j=1}^5 w_{ij} x_{ij}$$

From "Reliability of Function Points Measurement. A Field Experiment," by Chris F. Kemerer

Adjusting for Other Factors

1. Data communications
2. Distributed functions
3. Performance
4. Heavily used configuration
5. Transaction rate
6. Online data entry
7. End user efficiency

0 – No Influence



5 – Very Influential

Adjusting for Other Factors

8. Online update
9. Complex processing
10. Reusability
11. Installation ease
12. Operational ease
13. Multiple sites
14. Facilitates change

0 – No Influence



5 – Very Influential

Value Adjustment Factor (VAF)

$$VAF = 0.65 + 0.01 \cdot \sum_{i=1}^{14} r_i$$

where r_i is the rating of factor i

From "Reliability of Function Points Measurement. A Field Experiment," by
Chris F. Kemerer



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Adjusted Function Points (AFP)

$$AFP = UFP \bullet VAF$$

From "Reliability of Function Points Measurement. A Field Experiment," by
Chris F. Kemerer

Function Points Model

Advantages

- Estimation data available early
- Language and implementation independent
- Non-technical estimation

Disadvantages

- Difficult to automate data collection
- Possible subjective counting of function points

SLOC-based Models

Advantages

- Easy to automate data collection
- Easy to understand SLOC concept

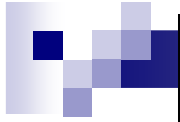
Disadvantages

- Highly subjective estimate of SLOC
- Highly dependent on experience
- Difficult calibration for a non-native environment

Conclusion

“ ...even the current cost is small relative to the large sums spent on software development and maintenance in total, and managers should consider the time spent on FP collection and analysis as an investment in process improvement of their software development capability.”

– Chris F. Kemerer, “Reliability of Function Points Measurement. A Field Experiment”



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Questions?