

The Software Bug All Stars

... and what we can learn from them



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Why should I care?

84B €

**Annual losses
caused by
software bugs**

(iX study from 2006)

36%

(14B €)

**of all IT budgets
spent to fix
software bugs**

(iX study from 2006)

Schadenfreude

"Schadenfreude is the experience of pleasure, joy, or self-satisfaction that comes from learning of or witnessing the troubles, failures, or humiliation of another."

(Wikipedia)

Let's see the stars

Mars Climate Orbiter

(1999)

Mars Climate Orbiter

What happened?

**No contact with space probe
after orbital insertion at Mars**

Mars Climate Orbiter

What happened?

**\$ 327 Millionen
spacecraft lost**

Mars Climate Orbiter

What happened?

Planned orbit: 150 km

Actual orbit: 57 km

Mars Climate Orbiter

Causes

**Different teams working
on different subsystems**

(Lockheed Martin & NASA)

Mars Climate Orbiter

Causes

**Lockheed Martin used
imperial units**

(Pounds of Force)

NASA used SI units

(Newton)

Mars Climate Orbiter

Causes

**The ground teams actually
realized something was wrong**

**... but management chose
to ignore them**

Mars Climate Orbiter

Lessons to learn

What can we take away?

"this surely can't happen to us... or can it?"

Mars Climate Orbiter

Lessons to learn

```
public int getTotalAmount();
```


Lessons to learn

```
/**  
 * @returns  
 *   the total amount the customer should be billed  
 */  
public int getTotalAmount();
```

Lessons to learn

```
/**  
 * @returns  
 *   the total amount the customer should be billed  
 *   (in EUR)  
 */  
public int getTotalAmount();
```

Lessons to learn

```
/**  
 * @returns  
 *   the total amount the customer should be billed  
 */  
public int getTotalAmountInEUR();
```


Lessons to learn

```
/**  
 * @returns  
 *   the total amount the customer should be billed  
 */  
public MonetaryValue getTotalAmount();
```

Mars Climate Orbiter

Lessons to learn

**Solid API design
(e.g. types and value objects)**

Lessons to learn

```
long lockoutDuration = 57600000;
```

```
long lockoutDuration = 16 * 3600000;
```

```
long lockoutDuration = 16 * 60 * 60 * 1000;
```

```
Duration lockoutDuration = Duration.ofHours(16);
```


Mars Climate Orbiter

Lessons to learn

Avoid "magic numbers"

Mars Climate Orbiter

Lessons to learn

**If you see something:
Do something!**

Therac-25

(1980s)

Therac-25

What happened?

**Three people died
from an overdose
during radiation therapy**

Therac-25

What happened?

**The manufacturer told the doctors
that the Therac-25 could not
overdose a patient**

... after the accident happened

Therac-25

Causes

**Race Condition
when entering data**

Therac-25

Causes

One (1) developer

... who was also responsible for QA

Therac-25

Causes

Error messages like

“Malfunction 54”

**that operators did not
know how to interpret**

Therac-25

Causes



Therac-25

Lessons to learn

What can we take away?

"this surely can't happen to us... or can it?"

Therac-25

Lessons to learn

**Be humble and don't dismiss
the fact that it might be you!**

Therac-25

Lessons to learn

**Every developer is biased
towards his/her results**

"This can never happen!"

Therac-25

Lessons to learn

**Build technical and
organizational safeguards**

Therac-25

Lessons to learn

**Don't just show error messages
but provide details and options**

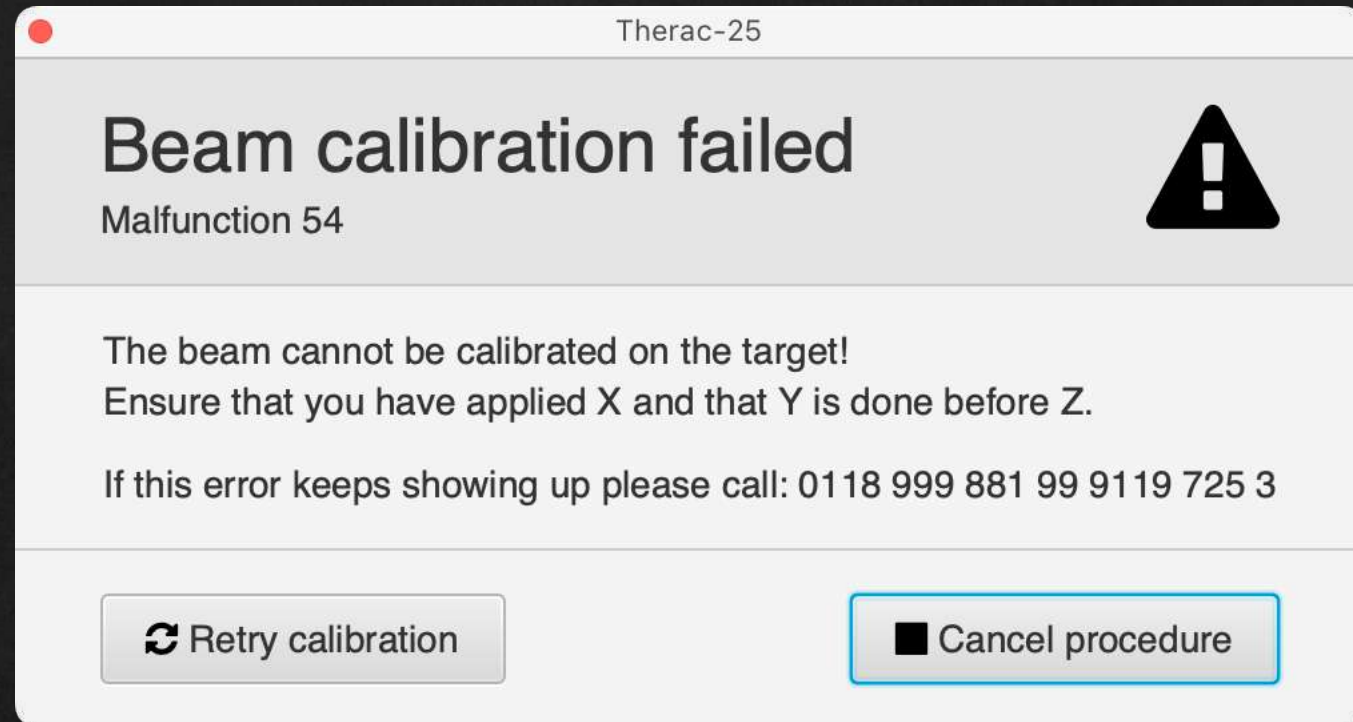
Therac-25

Lessons to learn



Therac-25

Lessons to learn



Microsoft Zune

(31.12.2008)

Microsoft Zune

What happened?

Nothing

Literally. The device simply didn't respond anymore.

Microsoft Zune

What happened

Edge case in date handling

(31.12.2008)

Microsoft Zune

Causes

```
while (days > 365)
{
    if (IsLeapYear(year))
    {
        if (days > 366)
        {
            days -= 366;
            year += 1;
        }
    }
    else
    {
        days -= 365;
        year += 1;
    }
}
```

Microsoft Zune

Causes

```
while (days > 365)
{
    if (IsLeapYear(year))
    {
        if (days > 366)
        {
            days -= 366;
            year += 1;
        }
    }
    else
    {
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}
```


Microsoft Zune

Causes

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    }
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```

31.12.2008

days = 366 (!)

Microsoft Zune

Causes

```
while (days > 365)
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    {
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    }
    else
    {
        days -= 365;
        year += 1;
    }
}
```

31.12.2008

days = 366 (!)

**... but iOS wasn't really
that much better**

(01.01.2012)

iOS

What happened?

The iOS alarm clock didn't work

(01.01.2012)

iOS

Causes

Week based year

iOS Causes



Patrick McCarron

@McCarron

Folgen



Antwort an [@charlesarthur](#)

[@charlesarthur](#) If you use a date format string of YYYY (vs yyyy) you get 2012 until 1/7 when it becomes 2013. Easy mistake to make, I have.

Original (Englisch) übersetzen

23:28 - 2. Jan. 2013

ios

Causes

2012 Januar	Mo	Di	Mi	Do	Fr	Sa	So
52 2011	26	27	28	29	30	31	1
1 2012	2	3	4	5	6	7	8
2 2012	9	10	11	12	13	14	15
3 2012	16	17	18	19	20	21	22
4 2012	23	24	25	26	27	28	29
5 2012	30	31	1	2	3	4	5

Microsoft Zune & iOS

Lessons to learn

What can we take away?

"this surely can't happen to us... or can it?"

Microsoft Zune & iOS

Lessons to learn

**Date and time handling
is (still) complicated
and has a lot of edge cases**

Microsoft Zune & iOS

Lessons to learn

**Use (and understand!)
proven tools, frameworks
and libraries**

Boeing 787 Dreamliner

(26.03.2020)

Boeing 787

Was ~~happened~~ ist still happening?

**Aircraft must be rebooted
every 51 days**

Boeing 787

Causes

**Historical data accumulates in
memory and might lead to
“display of misleading data”**

Boeing 787

Lessons to learn

What can we take away?

"this surely can't happen to us... or can it?"

Boeing 787

Lessons to learn

Don't be a polluter!

**Watch resource allocation
and clean up after yourself**

Wrapup

Nobody is perfect

Thank you!

The Software Bug All Stars



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Sources

Mars Climate Orbiter

Mars Climate Orbiter

https://en.wikipedia.org/wiki/Mars_Climate_Orbiter

How NASA Lost a Spacecraft Due to a Metric Math Mistake

<https://www.simscale.com/blog/2017/12/nasa-mars-climate-orbiter-metric/>

Metric vs Imperial Units: How NASA lost a 327 Million Dollar Mission to Mars

<https://everydayastronaut.com/mars-climate-orbiter/>

Therac-25

Therac-25

<https://en.wikipedia.org/wiki/Therac-25>

Fatal dose: Radiation Deaths linked to AECL Computer Errors

http://www.ccnr.org/fatal_dose.html

Microsoft Zune

The Zune Bug

<http://bit-player.org/2009/the-zune-bug>

iOS

Apple confirms New Year's alarm bug

https://appleinsider.com/articles/11/01/02/apple_admits_new_years_alarm_bug

Boeing 787

Boeing 787s must be turned off and on every 51 days to prevent 'misleading data' being shown to pilots

https://www.theregister.com/2020/04/02/boeing_787_power_cycle_51_days_stale_data/

Integrated Modular Avionics – Electrical Power – Repetitive Cycling

<https://ad.easa.europa.eu/ad/US-2020-06-14>

Other fascinating bugs that aren't covered by this presentation can be found at

https://en.wikipedia.org/wiki/List_of_software_bugs