Exploring Binary

Bicimals

By Rick Regan May 23rd, 2012

There is no widely accepted term for fractional binary numbers like 0.11001. A fractional decimal number like 0.427 is called a *decimal* or *decimal fraction*. A fractional binary number is called many things, including *binary fraction*, *binary decimal*, *binary expansion*, *bicimal*, *binimal*, *binary radix fraction*, and *binary fractional* (my term). In this article, I'm going to argue that **bicimal** should be the universal term.

(Please let me know what you think — take the poll at the end of this article.)

Why I Don't Like 'Binary Fraction'

Of all the existing terms, *binary fraction* is probably the most commonly used. I don't like it because its analog, *decimal fraction*, is not clearly defined. I want to avoid a term that inherits this problem.

Decimal fraction is commonly defined as any number with an explicit or implicit power of ten denominator, either entirely fractional or not. For example, 254/1000, 0.254, 15/10, and 1.5 are decimal fractions. But what about 2/5? It can be written as 4/10 or 0.4, although as written its denominator is not a power of ten. And what about 1/3? Its equivalent form as a decimal is $0.\overline{3}$ — a repeating decimal. It can never be written with a power of ten denominator. To make things more confusing, 2/5 and 1/3 are fractions — fractions written in decimal numerals.

You could argue that *decimal fraction* includes 2/5 but excludes 1/3 and still have a reasonable definition. However, I'm looking for the equivalent of *decimal*, a term which includes 0.4 and $0.\overline{3}$, but excludes 2/5, 4/10, and 1/3.

'Bicimal'

I discovered the term *bicimal* on the Web and in Google Books, but I don't know its origin. I pronounce it "bye' suh mull", or as Merriam-Webster might express it, \'bī-sə-məl\. A

bicimal is built with negative powers of two, whereas a decimal is built with negative powers of ten.

Like the term *decimal*, *bicimal* usually means a pure fractional value, like 0.11001. However, in some contexts, it could mean numbers with a whole and fractional part, like 101.11. In this case, nonnegative powers of two come into play — for the whole part.

Why I Like 'Bicimal'

Ideally, there would be a base-independent term for the fractional part of a number. I invented the term fractional for this purpose. I've called a fractional decimal number a *decimal fractional*, and a fractional binary number a *binary fractional*. The purpose of this new term was to separate the form of a number — a number with a "point" in it — from its base. If 0.427 is a decimal, does that make 0.11001 a binary decimal? You can see why we need a better term.

One problem with my terminology is that I've created two terms (*decimal fractional* and *binary fractional*) when I really only needed to create one. Why not stick with *decimal* and invent a new term just for binary? *Decimal* is easier to say than *decimal fractional*, and everyone knows what it means. So what's a good replacement for binary fractional? I've come to like the term **bicimal**.

At first glance, there's not much to like about *bicimal*. It's base-dependent, and it is a portmanteau for *binary decimal*. It is a poorly formed portmanteau at that. While the prefix 'bi-' is perfectly acceptable, its pairing with the suffix '-cimal' seems ill-formed. *Binimal* seems linguistically the better choice; it swaps out the prefix 'dec-' for the prefix 'bin-' and retains the suffix '-imal'.

On the other hand, say *bicimal* and *binimal* outloud, over and over; I think you'll find that *bicimal* sounds better, as do its associated terms: **bicimal point**, **bicimal places**, **bicimal part**, **terminating bicimal**, **repeating bicimal**, **infinite bicimal**, etc. And *bicimal* produces natural sounding phrases like "multiply bicimals", "convert a decimal to a bicimal", "convert a bicimal to a decimal", "convert a bicimal to a fraction", "convert a fraction to a bicimal", etc.

I think *bicimals* will be immediately understood by newcomers. It evokes all the feelings and terminology and operations of *decimals* (for better or worse :)). I don't think *binimals* — or

any of the alternative terms — has this property. So all things considered, I like *bicimal* the best.

What Do You Think?

Please leave a comment or take the poll (Polldaddy poll is available only if Javascript is enabled). **If you like *binary fraction*, please tell me why**. Also, please tell me how you'd pronounce *bicimal* — "bye' suh mull" ('bi-' with a long i) or "bih' suh mull" ('bi-' with a short i).

Which term do you prefer for fractional binary numbers like 0.11001?

Binary fraction

Bicimal

Binary fractional

Binimal

Other:

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Binary numbers / Decimals

21 comments

1. **James**

   May 23, 2012 at 12:42 pm

   It's interesting how no good, widely-used words have been made for this concept. It might be because exploring this sort of thing is not all that common. But I have some views on it.

   I think the usage of "decimal" to describe a radix fraction in the decimal base is just a lazy way of saying "decimal fraction" or something along those lines. I wouldn't try to mould the

binary equivalent around this colloquial use (despite it being very popular). This would lead me to say “binary fraction”.

I don’t see the same concerns as you for the multiple meanings of “decimal fraction”. Having said that, the only time I’ve seen it being used is on the DozensOnline boards, where things are presumed to be about number bases unless otherwise stated. But the fact that I haven’t heard it anywhere else suggests that the term is free for use.

If you want to use an analogue to “decimal”, the correct term would probably be “secondal”. This is because the “decim” bit comes from the Latin for tenth (ordinal) – anything “decimal” is “of the tenth thing”. But I don’t think that that would catch on.

Dozenal is very lucky to have its own custom Latin word for this concept – “uncial”. Compare Latin “uncia” (meaning “twelfth (fraction)) to “inch” and “(Troy) ounce”. We like to point that out to people. 😉

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2. **James**

May 23, 2012 at 12:46 pm

And by the way, I’ve heard someone say “bicimal” before, but I think they used pronunciation /ˈbɪsɪməl/. It’s probably a personal choice.

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3. **Rick Regan**

May 23, 2012 at 3:11 pm

@James,

I’ve wondered the same thing — why there is no accepted term. Binary numbers became relevant with computers, and in that context we talk in the language of implementation, like “decimal to floating point”, etc. I’m trying to think of binary numbers in a pure mathematical context; presumably not many people do that.

So what *is* the definition of *decimal fraction* as you see it on the DozensOnline boards?

It’s interesting that you view the prefix as ‘decim-’ and I view it as ‘dec-’ Looking now at Wikipedia, I see they define the prefix as ‘deci-’

Uncials — cool, I hadn't heard of that. So do you have an uncial point and uncial places, etc.? Uncial fractions? (And how are they defined?)

Thanks for weighing in!

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4. **Pat**

May 24, 2012 at 3:26 pm

Rick,
The act of creating language (especially if language already exits) should generally be avoided; but I think a term like biscimal would be a nice shorthand for the "binary decimal" which seems quite common. The test is in whether other people use it... but I think I would use it (at least for a while with something like base two fractional, in parentheses.

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5. **Rick Regan**

May 24, 2012 at 3:40 pm

@Pat,

I've been struggling with that issue ("creating language") for a long time now. My need for good terminology has been growing stronger and stronger. I was happy when I discovered the terms 'bicimal' and 'binimal'; it meant that I could replace my made up language ('fractional'). I'm hoping that with enough feedback, I can settle on one of those terms. They are the only two existing terms that give me what I want.

Thanks for the feedback.

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6. **Sue VanHattum**

June 11, 2012 at 12:26 pm

Binimal sounds too much like minimal. I think you made the right choice.

I'd tend to pronounce it with a short i.

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7. **Mary O'Keeffe**

June 13, 2012 at 10:26 pm

I have used bimal for years, and somehow imagined it was standard, though I can't find anyone else using it at the moment.

Bimal seems efficient, succinct, and to the point–in short, it is an elegant solution.

The c in bicimal seems unnatural to me, given there is no c in the root word binary.

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8. **Rick Regan**

June 14, 2012 at 8:53 am

@Mary,

I had seen one use of the term *binal*, but not *bimal* (although I did find one now after searching for 'binary bimal'). In any case, I prefer *binimal* to *bimal*; the extra syllable makes it sound more like *decimal* (which is why I like *bicimal* even more, despite the 'c').

Of course, I've been saying *bicimal* in my head for a month now, so it's starting to sound natural. Having used *bimal* for years you probably feel similarly.

Thanks for weighing in.

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9. **Brian Krent**

March 22, 2015 at 11:42 pm

I'll have to think about it further, but "bicimal" is an ugly combination. Leaving the "ci" from "deci" in there is not appropriate. At first glance, "bimal" as a word (not talking about its definition yet) seems better, but I haven't put much thought into it. A "bimal" is a "binary numeral"; as such, encompasses both "binary integers" and "binary fractions".

Just to note some things:
"denary numeral system" / "decimal system" / "base ten numeral system"
...

"quaternary numeral system" / (n/a) / "base four numeral system"
"ternary numeral system" / (n/a) / "base three numeral system"
"binary numeral system" / (n/a), but proposed "bimal system" / "base two numeral system"
"unary numeral system" / (n/a) / "base one numeral system"

At first glance, it seems that "decimal numeral" is a redundant phrase because "deci" and "numeral" merged together form "decimal".

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10. **Brian Krent**

March 22, 2015 at 11:43 pm

See also, numeral prefixes; differences between Latin Cardinal, Latin Multiple, Latin Distributive, Latin Ordinal, Greek Cardinal, and Greek Multiple:
http://en.wikipedia.org/wiki/Numeral_prefix

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11. **Brian Krent**

March 23, 2015 at 12:57 am

At second glance, the "-mal" meaning/usage with regard to positional numerals systems is debatable. Cf. Medieval Latin "decimalis", from Latin "decimus", from "decem", ten + adjective suffix "-alis". Honestly, "binary fraction" and "denary fraction" carry less ambiguity to me at this moment. I will consider this further another time.

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12. **Brian Krent**

March 23, 2015 at 1:01 am

Rather, I should say "binary positional fraction" (or "fractional position in the binary numeral system") or "denary positional fraction" (or fractional position in the denary numeral system") to just refer to fractions retaining to positions within the respective positional numeral systems, since "binary fractions" and "denary fractions" are a superset of "binary positional fractions" and "denary positional fractions" respectively.

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13. **Brian Krent**

March 23, 2015 at 1:04 am

Sorry for the various typographical errors in that last comment. I should have proof read before submitting. Notably, the word "retaining" was supposed to be "pertaining".

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14. **Brian Krent**

March 23, 2015 at 1:07 am

Also, to clarify, I meant "superset" in terms of definitional usage. Not in terms of numerical usage/representation.

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15. **Michael Evans**

March 11, 2016 at 11:04 pm

I liked "bimal" for the reasons given by Mary. However, here's a belated and much more plebeian thought on this subject. Of course, a fraction is just a part of something. It may be represented as an equation (like decimal 2/5) or represented as a number with the denominator being implied by the number's position after a marked "point" (like decimal 0.4). Many common English words are ambiguous without any context and that's OK. A "fraction", "point fractional", "positional fraction" or whatever you might call it, could apply in ANY base. The numerical base being used would likely be implied by context. The base could be described explicitly when needed. I'm sorry if this doesn't really address the topic but, to me it seems relevant.

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16. **Rick Regan**

March 12, 2016 at 9:58 am

@Michael,

That the term "decimal fraction" exists is testament to your comment.

I find myself using "fractional" when being base-independent, but I prefer "bicimal" over "binary fractional" or "binary fraction" when being base two specific.

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17. **Robert**

May 26, 2016 at 11:56 pm

I like bicimal. How about octimal and heximal as well?

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18. **Rick Regan**

May 27, 2016 at 2:40 pm

@Robert,

Those seem like good choices as well.

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19. **Lia P.**

August 18, 2016 at 1:19 am

As a newcomer to programming, 'bicimal' was what I searched for to find out if this concept existed. I definitely get the linguistic ickiness of the word, but for what it's worth, 'bicimal' was my first intuitive guess. Very much agree with you that 'bicimal' sounding like 'decimal' makes it easier to understand in associated phrases, too.

(Pronounced mine with a short i!)

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20. **Ian**

January 9, 2017 at 3:54 am

Bicimal offends the latinist in me because the 'C' is just the last letter of 'dec' left there. Decimal comes from the latin for 10ths, so the binary equivalent should come from dimidium, which is 'half'. so dimidal would be a better match.

As a programmer, of course, I have learned to steer clear of 'dimidals' because they generally cause more trouble than they're worth, especially when mixed with decimals.

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21. **Rick Regan**

January 9, 2017 at 5:51 pm

@Ian,

Thanks for the feedback. Yes, I agree on the ‘C’ part. But I like dimidal even less than binimal (kind of sounds like daffodil).

Comments are closed.