UNIVERSAL CLOCKS

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http://dozenal.ae-web.ca/clock/universal

The two sets of universal clocks in this project operate on UTC (Co-ordinated Universal Time), to demonstrate how time may be kept in a time-zoneless world. The main result of clocks running on UTC is that the time is the same everywhere. The pros and cons of such timekeeping are discussed elsewhere; these clocks enable thorough use of UTC in practice. They are the only ones this writer knows of that allow choice of location, time band, and many other parameters. They also display both traditional and dozenal clock faces, eight each in many ways, using analog hands and a digital readout.

To know which part of the day a given UTC indicates, we must know the local offset according to longitude, not least to recognize when the day begins. Locations a certain distance apart will have the same offset, that distance being determined by the choice of time band, analogous to the current concept of time zone.

Two offsets are indicated on these clocks: the beginning of the overnight phase (local midnight) and of the afternoon phase (local noon). Midnight may be UTC 00:00 (on a 24-hour clock) in London, but in New York (longitude -74°) it is later: about UTC 05:00, and in Satara, Maharashtra, India, equidistant on the other side of 0° (longitude +74°), it is earlier: about -05:00, i.e. 19:00.

In UTC, the day starts everywhere when it is midnight at Greenwich (0° longitude), also when it is noon 180° away. A variation on that involving Munich and 180° from it will be mentioned below.

The negative longitudes (with offsets less 12:00) have a later midnight than at 0°, and the positive longitudes (with offsets more than 12:00) an earlier midnight. The negative longitudes (with offsets more than 12:00) have an earlier noon than at +/-180°, and the positive longitudes (with offsets less than 12:00) a later noon.

Assuming only continuous equidistant numbering on a round face from 1 to 12 or the equivalent, there are many formats of clocks possible, more than are presented here. Those interested only in traditional clocks may skip the discussion of the dozenal clocks and go to the second set of three asterisks below.

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It is much easier to understand UTC clocks if we use a 24-hour method of timekeeping, including on a clock face. The dozenal clocks in this project do that,

in the dozenal number base. Dozenal counting and arithmetic are explained in many places on the Internet. They are better than using tens (the decimal system) and not hard to learn. The only initial oddities are the single digits for ten and eleven, because in dozenal 10 means twelve plus zero, not ten plus zero. Consequently, ↊ is ten and ↋ is eleven. Those digits have been used that way for more than a century and a half.

The dozenal clocks will be discussed first, followed by the traditional clocks. More about dozenal time reckoning is available here in either of the files titled *About this clock*. From here on, a subscript *z* indicates a dozenal number.

The chart below indicates the essence of the eight dozenal clocks. The explanation follows. Some clocks seem better than others; usefulness will be determined by users.

Clock	coloured arcs	shortest hand	numerals	foll UTC sun	foll local sun	phases from
1a	stationary	rotates	stationary	sh hand	---	sh hand
2a	stationary	stationary	rotate	0	---	0
3a	stationary	rotates	stationary	---	sh hand	sh hand
4a	stationary	stationary	rotate	---	0	0
1b	rotate	rotates	stationary	sh hand	*	0
2b	rotate	stationary	rotate	0	*	sh hand
3b	rotate	rotates	stationary	---	sh hand	0
4b	rotate	stationary	rotate	---	0	sh hand

Notes: The coloured arcs represent the phases of the local day.
foll: follows
sh: shortest hand
phases from: what indicates the phases.
*Two points on the arcs follow the local sun.

A Clocks
The coloured arcs, which represent the phases of the local day, are stationary.

Clock 1a. The shortest hand follows the UTC sun if the left is considered east or the hands move counterclockwise with east to the right. The shortest hand also indicates the phases of the local day.
Clock 2a. The shortest hand is stationary and the numerals rotate. The 0 follows the UTC sun if the right is considered east and the other hands move clockwise. The 0 also indicates the phases of the local day.
Clock 3a. The numerals are offset counterclockwise according to longitude. The shortest hand follows the local sun (conditions as in Clock 1a) and indicates the phases of the local day.

Clock 4a. The numerals are offset clockwise according to longitude. The shortest hand is stationary and the numerals rotate. The 0 follows the local sun (conditions as in Clock 2a) and indicates the phases of the local day.

B Clocks
The coloured arcs, which represent the phases of the local day, rotate.

Clock 1b. The shortest hand follows the UTC sun if the left is considered east or the hands move counterclockwise with east to the right, and two ends of arcs follow the local sun. The 0 indicates the phases of the local day.
Clock 2b. The shortest hand is stationary and the numerals rotate. The 0 follows the UTC sun if the right is considered east and the other hands move clockwise. Two ends of arcs follow the local sun. The shortest hand indicates the phases of the local day.
Clock 3b. The numerals are offset counterclockwise according to longitude. The shortest hand follows the local sun (conditions as in Clock 1b). The 0 indicates the phases of the local day.
Clock 4b. The numerals are offset clockwise according to longitude. The shortest hand is stationary and the numerals rotate. The 0 follows the local sun (conditions as in Clock 2b). The shortest hand indicates the phases of the local day.

Here is a guide to the user choices for each dozenal clock.

Override. Co-ordinates may be entered, in decimal only: latitude between -90° and +90°, longitude between -180° and +180°. Clicking on *Go to override* activates them.

Phases o/a. The overnight phase, abbreviated *O,* indicated by the grey arc, begins at local midnight. The afternoon phase, abbreviated *A,* indicated by the yellow arc, begins at local noon. The morning phase is indicated by the blue arc, and the evening phase by the red arc.

Band width. The measure is dromal lengths, or pentqua lengthels, from the Primel metrology. Those and **Pos'n (Position)** depend on the band chosen (see **Time band** below).

Under the hamburger icon are found the following.

Clocks A or **B.**
Clock 1, 2, 3, or **4.** See above for the descriptions of A and B and each clock.

Dozenal or **Traditional.** If Dozenal, the clock is diurnal (24-hour); if Traditional, semidiurnal (2 x 12 hours) with the usual sexagesimal division of the hours and minutes.

Clockwise or **Counterclockwise.** The hands may move in either direction.

Origin bottom or **Origin top.** The first of those represents midnight at 0° longitude, the second one noon at +/-180°. For *Origin bottom,* longitude 0° (for Greenwich), and time 000_z (00:00 on a 24-hour clock), the 0 will be at the bottom of each clock. For *Origin top,* longitude +/-180°, and time 000_z, the 0 will be at the top of each clock. Corresponding values for Munich are longitude 11.56406° and -168.43594°.

Greenwich or **Munich.** Longitude 0° may be at Greenwich, England or repositioned at 11.56406° to the east, in Munich, Germany. If the latter, longitude +/-180° passes through the least amount of land in the Pacific Ocean between the North Pole and Antarctica. If *Munich* is chosen, it generates the UTC value in place of Greenwich.

Time band. The time bands range from 100_z trices wide (1 dwell, 10_z of them around the Earth) to 0.01_z trice (1 twinkling, $100{,}000_z$ of them around the Earth) to continuous. The default value, 60_z, is the equivalent of 15° or 1 hour.

Low inputs such as 1 twinkling are of questionable accuracy. They are available for experimental purposes. The designation *Continuous* is largely imaginary: a band width of 0, infinitely many of them around the Earth. Here it is essentially the same as 1 jiff (0.001_z trice), because the values go only to three dozenal places.

The time band together with the latitude determines the **Band width** and the **Position.** In an amount out of 100_z (perbiqua or pergross), the latter indicates how far the location chosen is from the band's border. If *Origin bottom* is chosen, the border involved is the one closer to Greenwich (or Munich). If *Origin top,* the border involved is the one closer to +/-180° from Greenwich (or Munich).

Digital time format. The display has 1, 2, or 3 digits after the point.

000+ or **1000+.** Operates only in Dozenal. With the second option, $ƐƐƐ.Ɛ_z$ will advance to 1000.0_z instead of 000_z, and throughout the day the time will always increase, running from a 3-digit number to a 4-digit number.

Stop time. Any time of day may be chosen or inserted. The format is 00:00(:00), and the reference is UTC Greenwich (or Munich).

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The traditional clocks are analogs to the dozenal. Their principles are the same. Some things continue to work but others do not. For example, no hand or

numeral may follow the sun, because it moves too quickly, having to cover an entire rotation in only half a day. Mapping one day onto one circumference or rotation of the Earth requires a hand or numeral to move around the clock once a day.

That is possible on a set of hybrid clocks. Rotation once per day of the hour hand and/or of the numerals in the opposite direction combines with the current rotation of the faster hands to produce a 24-hour clock. Then the hour hand, the 0, or both would follow the sun. Those clocks, however, are not part of this project.

Here is what happens on the traditional clocks to each of the user choices above.

A Clocks
The coloured arcs, which represent the phases of the local day, are stationary.

Clock 1a. The shortest hand indicates the phases of the local day.
Clock 2a. The shortest hand is stationary and the numerals rotate. The 12 indicates the phases of the local day.
Clock 3a. The numerals are offset is offset counterclockwise according to longitude. The shortest hand indicates the phases of the local day.
Clock 4a. The numerals are offset clockwise according to longitude. The shortest hand is stationary and the numerals rotate. The 12 indicates the phases of the local day.

B Clocks
The coloured arcs, which represent the phases of the local day, rotate.

Clock 1b. The 12 indicates the phases of the local day.
Clock 2b. The shortest hand is stationary and the numerals rotate. The shortest hand indicates the phases of the local day.
Clock 3b. The numerals are offset counterclockwise according to longitude. The 12 indicates the phases of the local day.
Clock 4b. The numerals are offset clockwise according to longitude. The shortest hand is stationary and the numerals rotate. The shortest hand indicates the phases of the local day.

Override. Same as for Dozenal. Co-ordinates may be entered, in decimal only: latitude between -90° and +90°, longitude between -180° and +180°. Clicking on *Go to override* activates them.

Phases o/a. Same principle as for Dozenal. The overnight phase, abbreviated *O,* indicated by the grey arc, begins at local midnight. The afternoon phase, abbreviated *A,* indicated by the yellow arc, begins at local noon. The morning phase is indicated by the blue arc, and the evening phase by the red arc.

Only two phases appear at a time, because the clock displays only half a day at a time. At local noon, the colour pair switches from grey-blue to yellow-red; at local midnight, the colour pair switches the other way.

Band width. The measure is kilometers and miles. Those and **Pos'n (Position)** depend on the band chosen (see **Time band** below).

Under the hamburger icon are found the following.

Clocks A or **B.**
Clock 1, 2, 3, or **4.** See above for the descriptions of A and B and each clock.

Dozenal or **Traditional.** As noted above. If Dozenal, the clock is diurnal (24-hour); if Traditional, semidiurnal (2 x 12 hours) with the usual sexagesimal division of the hours and minutes.

Clockwise or **Counterclockwise.** Same as for Dozenal. The hands may move in either direction.

Origin bottom or **Origin top.** The default value for Traditional is *Origin top,* although *Origin bottom* may be chosen.

For *Origin bottom,* at longitude 0° or +/-180° and time 00:00 or 12:00, the 12 will be at the bottom of each clock. For *Origin top* and the same conditions, the 12 will be at the top of each clock. Corresponding values for Munich are longitude 11.56406° or -168.43594°.

Greenwich or **Munich.** Same as for Dozenal. Longitude 0° may be at Greenwich, England or repositioned at 11.56406° to the east, in Munich, Germany. If the latter, longitude +/-180° passes through the least amount of land in the Pacific Ocean between the North Pole and Antarctica.

Time band. The time bands range from 2 hours wide (12 of them around the Earth) to 1 second (86,400 of them around the Earth) to continuous. The default value, 1 hour, is 15° in circumference.

The designation *Continuous* is largely imaginary: a band width of 0, infinitely many of them around the Earth. Here it is essentially the same as 0.1 second, because the values go only to one decimal place.

The band together with the latitude determines the **Band width** and the **Position.** In a percentage, the latter indicates how far the location chosen is from the band's border. Unlike for Dozenal, regardless of whether *Origin bottom* or *Origin top* is chosen, the border involved is the one closer to Greenwich (or Munich).

Digital time format. The display is in seconds or tenths of a second.

000+ or **1000+.** Does not operate in Traditional.

Stop time. Same as for Dozenal. Any time of day may be chosen or inserted. The format is 00:00(:00), and the reference is UTC Greenwich (or Munich).

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A further note on the clocks:

With UTC there is no local time. For some locations, a simulation of that in its current sense may be determined by subtracting the overnight offset from the UTC. Because daylight saving time is not part of UTC, it may be simulated by using a location 15° to the east of whatever is chosen originally.

Nonetheless, neither of those Ersatz procedures works if the original location is in a time zone not in accord with where the strict 24-part longitudinal division of the Earth puts it. For example, Huntington Woods, Michigan, USA, longitude -83.1669°, has an O offset from Greenwich of 300z (6:00), placing it in the North American Central time zone. But it is near the western end of the Eastern zone.

It is also a problem to think in terms of time zones when any band is chosen other than 60_z (1 hour). Some smaller bands seem advantageous, because they allow neighbouring areas to differ in offset by fewer than 60_z trices (1 hour).

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